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Current Science

Vol. XVIII]

JANUARY 1949

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QUALITY IN SCIENTIFIC RESEARCH

IN the course of his inspiring address to the Students and Staff of the Indian Institute of Science, Pandit Jawaharlal Nehru, Prime Minister of the Dominion of India, emphasised the need for maintaining a high standard of quality in the output of scientific research in this country. He deplored that the quality and output of scientific work was commensurate neither with the substantial amounts of money which were being invested on research nor with the potential talent which could be mobilised in the service of science. Except for a few brilliant examples, India's contributions to the world's scientific knowledge and technological advancement, have so far been admittedly meagre, considering the wealth of research material and human talent which are available in the country.

The first class quality of the available talent has been convincingly demonstrated by the exceptionally brilliant work which successive batches of our young men have achieved under the benign stimulus of a congenial and inspiring atmosphere which distinguishes most of the foreign centres of research. Many of these young scientists on their return to this country find themselves faced with a very discouraging "research climate" which stifles their enthusiasm and initiative, and most of them, in a couple of years, languish into scientific inactivity and are forced to adopt an uneventful and sterile career of administrative routine. Talent which should have been nurtured to its full glory and fruitfulness is thus lost to the country. Instances are not wanting to show that such

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of our students who have had an opportunity of establishing a career for themselves in Europe or America, have distinguished themselves further and attained scientific eminence. The career of the late Dr. Y. Subba Row who rose to the position of the Research Director of the Lederle Laboratories, is an illustrious example of such a case. All these facts prove the contention that we, in India, have not yet established a "Research Climate" which would nurture creative talent to its full stature. The causes which have led to this

unhappy state of affairs may well be scientifically and dispassionately elucidated by a specially constituted Committee of the Association of Scientific Workers of India to whom, after all, the responsibility of creating the right type of climate for research belongs. We, therefore, urge the immediate formation of a representative committee to go into the question and suggest ways and means by which the present research atmosphere could be altered.

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SIR S.S. BHATNAGAR ON THE NEEDS OF SCIENTIFIC MAN-POWER AND FUNDAMENTAL RESEARCH

IN the course of his Presidential Address to the National Institute of Sciences of India, Sir Shanti Swarup Bhatnagar surveyed the efforts of the Government of India in the cause of scientific research and referred to the setting up of the Atomic Energy Commission, the creation of National Professorship of Physics, arrangements of visits to India by celebrated foreign scientists and the work of the Council of Scientific and Industrial Research and various other National Laboratories in existence and in formulation. He also reviewed the activities of the National Institute of Sciences during the current year.

Referring to the appointment by the Government of the Universities Commission to inquire into and report on the conditions and prospects of University education and advanced research in India and to recommend a constructive policy in relation to their special problems and the needs of the country, he said.

"The development of science and industry in this country will need a large potential scientific man-power. While national laboratories and research institutes will play an ever-increasing part in furthering the application of science to industry, it is clear that ultimately we have to depend upon the Universities for an even and constant flow of scientific workers and leaders, imbued with zeal and zest for research.

"The fast changing world conditions and the new role of science necessitate a vital change in the outlook of the Universities and the Government.

"Universities have been rightly regarded as the fountain-head of knowledge and it is in their free atmosphere that we should look forward to vigorous pursuit of fundamental research. Fundamental research is the source from which extraordinary applications are likely to emerge and unless we keep ourselves in the forefront of fundamental work it is unlikely that we would make much original contribution to applied research. I would make a special plea to our Universities, our research institutes and our learned societies not to slacken their support for fundamental research."

He put in a strong plea for sufficient financial and material resources, appropriate to each stage of development and stressed the necessity of bold and flexible thinking in framing the policy of the Universities. While industrial research was the prime necessity for development, a vigorous pursuit of fundamental research was vital, being the source from which extraordinary applications were likely to emerge, he said. It was necessary for young men to follow in the wake of great scientists and blaze the path of the better world of tomorrow.

SCIENCE STAGES A COME BACK TO INDIA

IN a gracious message to the 36th session of the Indian Science Congress held at Allahabad during the first week of January 1949, His Excellency Sri Rajagopalachari, the Governor-General of India, said:—

"Science went out for a long journey from India some centuries ago and it looks as if

she has come back to her home now. May the session of the Science Congress at Allahabad be an auspicious festival of this return home. The future progress of science in India seems fairly assured if we could appraise it on the quality and industry shown by present-day doctors of science."

P.

RAMAN SPECTRA OF CRYSTALS AND THEIR INTERPRETATION*

ITS universal applicability, simplicity of technique, precision of results obtained and ease of interpretation make the Raman effect a powerful tool for the study of the structure of matter. The information yielded by Raman spectra has been of great value in the investigations of relatively simple molecules as well as of the more complicated polyatomic ones. Its utility in the investigations of the physico-chemical problems set by the crystalline state of matter is equally great. Although numerous papers have appeared on the Raman spectra of crystals since the discovery of the effect, very little progress was made till 1943 in using Raman effect data for the elucidation of the physical properties of solids. This state of affairs may be attributed to the fact that the physics of the solid state was dominated for many years by theories which had their birth before the discovery of the Raman effect. The reference here is to the well-known theories of solid behaviour originally put forward about the same time by Debye and by Max Born.

It is a significant fact that, subject to some noteworthy qualifications and exceptions, the modes of atomic vibration appearing in the Raman spectra of crystals are represented by sharp lines irrespective of the nature of the substance, or of the frequency of the vibrations. Basing himself on this and similar optical effects observed in crystals, e.g., luminescence and absorption spectra at low temperatures, Sir C. V. Raman (1943) formulated a new theory of lattice dynamics. The new theory leads among other things to the most important result, namely the vibration spectrum of a crystal consists essentially of a finite number of discrete frequencies. On the basis of the Raman theory, crystal lattice has in general $(24p-3)$ modes of normal vibration (excluding simple translations) in $(3p-3)$ of which all the units in the structure have the same phases, while in the remainder equivalent atoms in neighbouring cells along one, two or all three primitive translations vibrate with opposite phases. The experimental confirmation of this prediction became a matter of fundamental importance for the progress of crystal physics. As the available data on the Raman spectra of crystals were insufficient, it became necessary to carry out a series of investigations using an improved experimental technique to give a decisive answer to the following issues raised by the new lattice dynamics: (1) Are the vibrations in crystals which manifest themselves in the Raman spectrum, waves extending through the volume of the crystal, or are they the vibrations of the atoms in the individual cells of the lattice? (2) Is the complete vibration spectrum of the crystal in the infra-red region a continuous diffuse spectrum, or is it a discrete spectrum exhibiting a finite set of monochromatic frequencies?

*Abstract of the Presidential Address delivered by Prof. R. S. Krishnan, D.Sc., F.H.D. (Cantab.), F.A.Sc., to the Physics Section of the Indian Science Congress, Allahabad, 1949.

It has been the practice generally to use the $\lambda 4046$ and $\lambda 4358$ radiations of the mercury arc as exciter in the studies on the Raman spectra of crystals. The Raman lines excited by these radiations fall in the very region where the weak fluorescence exhibited by many crystals appear and where the spectrum of the mercury arc itself shows a weak continuum. Consequently feeble Raman lines may not be detected as they will appear overpowered by the continuum. In view of these difficulties, the technique of using the $\lambda 4046$ and $\lambda 4358$ radiations for the study of the Raman effect in crystals appeared to have already been pushed to the limit of its utility during recent years. It became clear that some radical improvement in the technique of study had to be effected in order to get further useful information about the Raman spectra of crystals. This was achieved by the so-called ultra-violet technique described below.

As is well-known, it is essential to employ a monochromatic light source which is very intense for recording the extremely feeble Raman scattering in crystals. It is also of great importance that there should be no continuous spectrum accompanying the same. This is secured by using the $\lambda 2533.5$ mercury resonance radiation from a water-cooled magnet-controlled quartz arc. The enormously increased scattering power of the resonance radiation arising from its exceptional intensity as compared with the other mercury radiations and from the λ^{-4} law has made it an ideal source for Raman effect studies in the case of crystals that are transparent to the ultra-violet and do not get coloured by prolonged exposure to this radiation. The $\lambda 2533.5$ radiation from the light scattered by the medium is effectively suppressed before its entry into the spectrograph by absorption in a column of mercury vapour, as otherwise the photographic plate would be fogged. This makes it possible to record faint Raman lines with small frequency shift on a clear background.

Using the improved experimental technique for exciting the Raman spectra, many crystals have been studied by Dr. R. S. Krishnan during the last five years and a rich harvest of results obtained in every one of the cases investigated. The results obtained in the case of diamond, rocksalt, potassium bromide, ammonium chloride and ammonium bromide afford a direct experimental verification of the predictions of the new theory of crystal dynamics. In all these cases, the second order Raman spectra exhibit a series of sharply defined frequency shifts. The numerical evaluation of the eleven frequencies for the above crystals on the basis of the new lattice dynamics leads to results in good agreement with observational data. Their activities in light-scattering and in infra-red absorption are also in accordance with the theoretical predictions.

From the experimental facts presented herein on the Raman spectra of crystals, it is clear that the parts of the vibration spectrum in the lower and upper ranges of frequency differ radically in their behaviour. The first part is totally inactive in light scattering,

while the second part is strongly Raman active giving an intense second order spectrum. The character of the spectrum is also totally different in the two ranges of frequency. While the spectrum of the elastic vibrations is necessarily a continuous one, the discrete nature of the atomic vibration spectrum in the upper ranges of frequency is clearly manifested in the second order Raman effect; overtones and summations of the primary vibration frequencies appear under adequate instrumental power clearly resolved into numerous closely spaced sharp lines. These differences are fundamental and will compel anyone to recognise that the two parts of the vibration spectrum are physically different. In the

lower ranges of frequency, we are concerned with elastic waves traversing the crystal from end to end and forming stationary wave-patterns, while in the upper ranges of frequency, we are concerned with the vibrations of the atoms in the individual cells of the crystal lattice. The spectroscopic facts thus give a decisive answer to the theoretical issues stated at the end of the second paragraph. They show that the assumptions on which the Debye and Born-Karman theories are based are unjustified and that the conclusions regarding the nature of the atomic vibration spectra to which those theories lead are altogether untenable.

PREPARATION OF ADENOSINE TRIPHOSPHATE FROM BULL FROGS

B. B. DEY, H. C. FRIEDMANN AND C. SIVARAMAN
(Bio-Chemical Laboratory, University of Madras)

IT has been known for some time that the phosphorylation of glucose by means of adenosine triphosphate (A.T.P.)—or adenylyl pyrophosphate, as it is sometimes called—under the influence of the so-called "Hexokinase", an enzyme found in yeast by Meyerhof,¹ and the occurrence of which has also been recently demonstrated in animal tissues,^{2,3} plays an all-important role in the carbohydrate metabolism of animals. The reaction has assumed added importance and interest in the light of the new theory of Dixon and Needham⁴ of the action of vesicant poison gases and of the observations made recently by Price, Cori and Colowick⁵ and by Colowick, Cori and Stein⁶ that the activity of animal hexokinase is inhibited *in vitro* by certain extracts of the anterior pituitary glands, and that this inhibition is counteracted again by the pancreatic hormone, Insulin. Fresh light appears thus to be thrown on the mechanism of the long known antagonism between certain hormones, that in the present case being correlated with the activities of a particular enzyme system in the body.

The adenosine triphosphate required for some of the preliminary investigations carried out in this laboratory was prepared from the thigh and hind leg muscles of frogs by a slight modification of the original method due to Lohmann.⁷ The process would appear to be both simple and efficient when compared with that described recently by Dounce, et al.,⁸ using rabbit muscles. There is no reflex action causing twitching of the frog muscles and the consequent fear of possible loss of A.T.P., when the brains of the animals are pithed under the conditions described below, thus dispensing with the necessity for the use of anaesthetics like Nembutal. The complicated procedure involved in the removal of stable organic phosphates which appear to be present only in traces in frog muscles as compared with the rather large amounts found in rabbits, and of inorganic phosphate, by means of alternate precipitations with mercuric nitrate in addition to barium acetate, is also found unnecessary. The preparation can be conveniently completed in 3-4 hours as compared

to 2-3 days' intermittent work, described by Dounce, et al.⁸ The experimental details under Indian conditions, are recorded here as they might be of interest to other workers in the field.

The bull frogs obtained locally weighed on the average 150 grams each. They were kept under ice and salt for about five minutes and then benumbed, taken out of the bath, stretched on a board and their brains pithed or smashed with a light blow from a hammer. The legs were then held by an assistant and the muscles rapidly excised using scalpels and scissors, the whole operation with a single frog lasting 1 to 1½ minutes. The muscles were placed immediately in a weighed flask immersed in a freezing mixture, the muscles quickly weighed and then passed through a "Latapie" mincer which had been cooled previously in ice. Approximately 100 grams of minced muscles were obtained from three bull frogs. The mince was allowed to fall directly into ice-cold 10 per cent. trichloroacetic acid (100 ml.) in an Erlenmeyer flask, shaken up repeatedly by taking out of the freezing bath for a few seconds at a time, and filtered through cloth at the pump into an ice-cooled receiver, after a few minutes. The residue was extracted once again with 4 per cent. trichloroacetic acid (100 ml.) in the same way and filtered. The total extract (225 ml. approx.) was centrifuged in the cold to free from precipitated proteins, the clear liquid treated with ice-cold N NaOH until only just acidic to Congo Red (50 ml. approx.) and then an equal volume of ice-cold alcohol (approx. 95%) was added. A slight precipitate, which separated after standing for a short time and which consisted mainly of glycogen,⁹ was centrifuged off. To the clear ice-cold alcoholic solution (50 ml. approx.) which still tested acidic to Congo Red, was added slowly from a burette a cold 2% solution of barium acetate until the solution ceased to be acidic to Congo Red (8 ml. approx.). The precipitate, which is the di-barium salt of A.T.P. together with some inorganic barium phosphate, was separated at the centrifuge and then shaken up with ice-cold water (75 ml. approx.) and

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the precipitate dissolved by the addition of a small amount of cold N HCl, about 6 ml. being found sufficient. A small amount of insoluble material was removed by centrifuging. To remove inorganic phosphates, the barium salt was again precipitated as described before by adding an equal volume of alcohol (75 ml. approx.) and then 25% barium acetate solution until the suspension was just alkaline to Congo Red, centrifuged and the dissolution, precipitation and centrifuging repeated two more times. Each dissolution required less HCl than the previous one, and more and more of the nucleotide salt was precipitated by alcohol each time. For the last precipitation no barium acetate or at most one drop was required to render alkaline to Congo Red. This is due to the formation of a mixture of the mono and the di-barium salts of A.T.P.,⁹ of which the former is soluble and the latter insoluble in water. It also explains the rather high phosphorus and nitrogen percentages of the product. The product is finally centrifuged, washed with alcohol of increasing strength and then with ether and dried in *vacuo* over sulphuric acid, at room temperature. 286 milligrams of a product containing only traces of inorganic phosphate were obtained from 3 bull frogs yielding 100 grams of muscle. The purity of the product was determined by estimating the ratio of labile or hydrolysable phosphate by hydrolysis with N HCl on boiling water-bath for 7 minutes — to stable phosphate by the method of Fiske and Subbarow,¹⁰ and also the total nitrogen. The data obtained from the analyses of two of the preparations are given below:—

Prep. i. 572 mg. Bi-salt were obtained from 202 grams of muscle derived from 6 bull frogs.

Total phosphate ..	11.58%
Hydrolysable phosphate ..	7.83%
Hence, hydrolysable P : stable P ::	
7.83 : 3.75, i.e., 2.09 : 1 (Theory, 2 : 1).	

Nitrogen 8.91%

Prep. ii. Similar yield.

Total phosphate ..	11.38%
Hydrolysable phosphate ..	7.49%
Hence, hydrolysable P : stable P ::	
1.94 : 1. (Theory, 2 : 1).	
Nitrogen	8.77%
$C_{10}H_{14}O_8N_5P_3 \cdot Ba_2H_2O$ requires N	9.8%
$C_{10}H_{12}O_8N_5P_3 \cdot Ba_2H_2O$ requires N	8.2%

In all preparations, inorganic phosphate directly estimated was negligible.

The sodium salt of A.T.P. was readily prepared from the barium salt by removing the barium directly with the calculated amount of N sulphuric acid, neutralising with N NaOH to pH 7.0 and centrifuging off the precipitated barium sulphate; as little as 1 ml. of solution can thus be prepared in 15 ml. graduated centrifuge tubes. For such small volumes a loss of A.T.P. due to adsorption on the barium sulphate¹¹ is unavoidable. The A.T.P. content of the solution is determined by estimation of the total phosphate. The salt is stored as barium salt in desiccator and solutions are prepared just before use. The compound appears most stable as sodium salt, stored in solution (pH 6.8) at -12°¹².

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NOR'WESTERS IN BENGAL

S. L. MALURKAR

(Colaba Observatory, Bombay)

THE arguments and the results from a study of winter rain in the U.P. are applicable to a study of nor'westers in Bengal. Bengal is a densely populated part of India where flat bottomed river craft form a chief mode of transport. The nor'westers cause damage to these river craft and sometimes cause loss of life.

Intensive meteorological observations have been taken in Bengal to study the nor'westers. Many workers have studied the various aspects of the phenomenon.¹ Quoting from Pramanik "Nor'westers or Kalbaisakhis (calamities of the month of Baisakh) are severe thunderstorms which occur in Bengal during the summer months March to May, some of which reach Tordanic violence and cause considerable damage to property and sometimes even loss of life. The winds in these thunderstorms come generally from some north-

westerly direction and hence they are called nor'westers. In some cases, funnel-shaped clouds characteristic of tornadoes have been noticed.....It is generally agreed that the nor'westers are not 'local heat' thunderstorms. This appears to have been recognised by Eliot as early as 1876. They also do not occur when the whole of north-east India is over-run by one air mass, i.e., during winter when west to north-west winds prevail and during the periods of strong monsoon when moist winds from the Bay prevail. They occur mostly during the transition period from the winter season to the rainy season, i.e., when two different air-masses, west to northwest winds of land origin and moist winds from the Bay co-exist over Bengal".

Eliot brought in the idea of a cold wedge. M. G. Subramanyam used to say that though there was a southerly feed in the lower levels

of upper air, there would be no 'nor'wester unless a low pressure wave (shown by the movement of a negative pressure change or negative pressure departure or an actual low pressure area) passed over Bengal. Sôhoni found that nor'westers occurred mainly when there was a passage of depression or low pressure wave from the west towards N.E. India and there was a west to east pressure gradient over Bengal. Sen suggested that cold wedges of air from Assam coming down the valleys and undercutting the warm moist winds from the Bay of Bengal gave the nor'westers. Ramanathan used to talk of an incursion of Chinese or Mongolian air but to the author's knowledge did not further pursue the problem. Chatterjee and Sur tried explaining the inversions over lower Bengal in April and May as similar in type to those first observed by J. H. Field over Karachi in August and September 1905. The inversion over Karachi was, they said, due to the same cause, but the history of the dry air over-running the moist air over Karachi was different from that of the dry air over Bengal. They also said that one nor'wester may act as a 'trigger' for a neighbouring one.

The actual method, the writer used in the course of his routine work was based on the analysis of the western disturbance into a number of secondary low pressure areas. When any of these low pressure areas were expected to cross Bengal or its longitude, and when sharp wedges³ of high pressure formed whose tips were directed in some westerly or southerly direction the situation was watched as being favourable for the production of nor'westers.

Most of the workers are convinced about a shallow layer of southerly feed from the Bay of Bengal, and about the eastward passage of a low pressure wave. Both these are satisfied if a split up low pressure area of a western disturbance (as analysed above) is passing over Bengal. The secondary is situated in about the latitude of 25° N. The effect of it on upper air circulation would be confined to about 2 or 3 kms, and this would give the "shallow" moist feed. Above the height of 2 or 3 km., as before, the circulation is determined by the rear of a more northerly secondary low pressure area of the western disturbance. Colder air than what was existing previously at those levels must be flowing at those higher levels. When the 'cold front' of the secondary low pressure area reaches the given locality, both the favourable conditions and an initial cause of convection are present as in the U.P. and thunderstorms should occur if no other circumstance intervened. This extraneous circumstance is due to the temperature inversion which persists all the time in the pre-monsoon months and gets broken only during the thunderstorms.

The southerly feed is from the sea and is naturally more moist than the corresponding feed in the U.P. The air can generally be classified as tropical Maritime air (Tm). It undergoes latitudinal convergence and should produce rain easily if other circumstances like temperature inversion did not stand in the way.

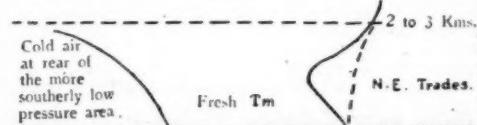
The Tropical Maritime air may also get sometimes mixed up with Equatorial Maritime air (En). The En which would have come from the other side of the equator, would be very moist and could be made easily unstable. Tm may also be fed by the bent back 'N.E. Trades' (Tr) which in the pre-monsoon months would be over Bengal. The situation would then resemble wet western disturbances*.

The role of tropical continental air over Bengal is similar to that in the U.P. At the higher level the rear of the more northerly secondary low pressure areas determine the circulation and the air is Tc. After the passage of the 'cold front' at the lower levels or the surface over a locality, the air even at lower level is Tc and hence homogeneous with the air above 2 km. It is quite explicable how if one depended on only available observational material, confusion could arise that the downward squall of one nor'wester acted as a 'trigger' for the next nor'wester in the neighbourhood.

Regarding the temperature inversion.—The temperature inversions at Karachi occur later in the year (June onwards). In between Karachi and south Bengal there is hardly any inversion. The 'N.E. Trades' are winds that have an equatorward motion and hence undergo latitudinal divergence, and exhibit temperature inversions.⁵ In the pre-monsoon months the N.E. Trades get displaced to South Bengal. The N.E. Trades may not be as hot and moist during the pre-monsoon months as in the monsoon. When the low pressure areas of a western disturbance moves eastwards, the N.E. Trades or Tr get an eastward displacement and at the same time Tr bends back to feed into the low pressure area. The bending back may be indicated by the high pressure wedges directed to west or south. The eastward displacement and bending back of Tr together, under the influence of a low pressure area, are sufficient to dynamically explain the disappearance of the temperature inversion over a locality.

Figure below is a vertical structure before the onset of a nor'wester. The receding Tr is shown by the dotted line (at the time of nor'wester).

Fresh Cold Air at the rear of a Northern Low Pressure Area of a Western Disturbance



Though the favourable conditions like fresh Tm at lower levels and fresh Tc at higher levels are present over a locality in Bengal, due to temperature inversion, and lack of marked orography, thunderstorms cannot occur unless the velocity gradient at the rear of the 'cold front' is large. But the effect of the 'cold front' by itself is on an average small in Bengal. The additional cause of

vertical convection is provided by afternoon heating or insolation. For vertical convection due to strong surface heating, there must be inequality, i.e., the isopycnics must not be horizontal.⁵ The distribution of rivers and land apparently provide the necessary contrast in surface heating. The rivers may play a part in postponing the time occurrence of the nor'wester.

In the nor'westers there is an absence of easily recognisable time sequence. Most of the nor'westers occur in the afternoons, i.e., are dependent on the afternoon heating or insolation. The main causes are due to insufficient wind velocity gradient at the 'cold front' due to lack of mountains and other marked orographic features and due to the temperature inversion. The temperature inversion can only break up if the low pressure area is marked. The low pressure areas of the western disturbances are not quite marked over Bengal. Insolation deepens the low pressure area. Hence the tendency to wipe out the inversion over a locality would be possible in the afternoons. The large river systems tend to disturb the even movement of the nor'westers.

The temperature inversion allows sufficient energy to accumulate until the explosive condition is reached, and may be responsible for the severity of the thunderstorms.

With an extended chart, it must be possible to trace all the air masses considered above.

But with a limited chart some helpful criteria can be given. The upper winds in and

around the Bay of Bengal and the weather there should be watched. An inflow of bent back Tr to a secondary low pressure over C.P. or Orissa area⁶ moving ENE wards towards Bengal was found to pre-indicate the occurrence of nor'westers. The inflow of Tr to the low pressure area could be deduced if the winds at latitudes south of about 17°N like Port Blair veered and become SE and the winds at stations to the north of the latitudes and almost to the west of Bengal were S.W. The winds in lower Burma and Tenassarim may also be used as for Port Blair. Here again, the time between the winds at Port Blair becoming S.E. and winds along North Madras and Orissa becoming S.W. and the onset of nor'westers can be decided after statistics have been collected over a long period. 36 hours may just be the outside limit.

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SOCIETY FOR THE STUDY OF THE HISTORY OF SCIENCE

THE need of forming a national society in India for the promotion of studies in the history of sciences in this part of the world was explained by Dr. Alexander Wolsky of UNESCO at a meeting of some delegates to the Science Congress at Allahabad on 3rd January 1949.

Dr. Wolsky explained the role which the UNESCO would play in his scheme of forming a National Committee or a Society in India. He said that the role of the UNESCO would be an indirect or passive one.

Dr. Wolsky thought that India with such a glorious past in the history of science was a bit neglected and there should be more active research in this direction. The rest

of the world should know far more about the scientific achievements of this country and it was really something which should attract attention all over the world.

Dr. Wolsky pointed out that a Society formed for the purpose of study of history of sciences in this part of the world would find it easier to ask for financial support from the International Union as he was confident it would be forthcoming.

After a short discussion of Dr. Wolsky's proposal, the Science Congress formed a committee with Prof. Banerjee as convener and with powers to co-opt, to formulate a scheme in this connection.

1851 EXHIBITION SCHOLARSHIP

ONE Science Research Scholarship will be awarded this year by the Royal Commissioners for the London Exhibition of 1851 to students from Indian universities or institutions having post-graduate departments of Science. The scholarship, which is of the value of £ 350 per annum and tenable for a period of two years, is intended to enable the selected student, who has already completed a full university course and whose record gives evidence of capacity for original scientific investigation, to devote himself to post-graduate research in some branch of pure or applied Science at any

institution abroad approved by the Commissioners.

Subjects of the Dominion of India below the age of 26 on May 1, 1949, will be eligible for this Scholarship. Applications from students whether residing in India or abroad have to be recommended by the authorities of a university or an institution and are to be made to Provincial Governments and local administrations through the universities and institutions concerned who would forward them so as to reach the Secretary, Ministry of Education, Government of India, not later than March 10, 1949.

LETTERS TO THE EDITOR

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EMISSION SPECTRUM OF LEAD
IODIDE

CONTINUING the work on thallium iodide, the emission spectrum of the iodide of lead, the element next to thallium in the periodic table, is obtained in a high frequency discharge. Characteristic bands attributed to the diatomic molecule PbI_2 are obtained in the region $\lambda 6400 - \lambda 4300$. The bands are generally degraded towards the red, though some of them chiefly on the more refrangible end of the spectrum are headless and diffuse. A vibrational analysis of the bands has led to the following approximate constants.

$$\nu_e = 19509.6 \quad \omega_e' = 119.5 \quad \omega_e'' = 156.6 \\ \chi_e/\omega_e = 0.25 \quad \chi_e''/\omega_e'' = 0.30$$

The vibrational constants are found to be in keeping with those of the related iodide molecules in the same horizontal row of the periodic table and of the other halides of lead. The intensity distribution in the system is analogous to that in the emission bands of $PbCl_2$.

A full discussion of the analysis is being communicated shortly to the *Indian Journal of Physics*.

Andhra University, P. TIRUVENGANNA RAO,
Walair,
December 8, 1948.

GLUCOSE AS A BEVERAGE

In wine-growing districts there is sometimes a severe shortage of good milk and cheese except where cows are kept privately, and

excessive cultivation of grapes may interfere with adequate grazing of cattle.

Refreshing beverages are widely favoured but there is reason to object to much of the preserved mineral waters which have only partially supplied the demand for fresh-fruit juices instead of what may be kept indefinitely.

There is a common demand for some sweet beverage which may be taken repeatedly and for long periods with impunity and this is available with solutions of Glucose.

Invalids and convalescents are often recommended to take Glucose as a readily absorbed remedy for wasting disease and it should be encouraged among communities affected by malnutrition as well as to prevent acidosis.

Glucose is readily excreted by the kidneys, is a useful stimulant for persons about to undergo an operation and serves as a useful substitute for other flavouring of plain water.

If this beverage were more accessible among the poorer classes and became popular among the wealthy it would do much to supply a natural craving after sugar without producing the undesirable effects of alcoholic beverages.

Durban F. GORDON CAWSTON,
December 16, 1948.

THE DETERMINATION OF LINOLEIC
ACID IN GLYCERIDES

STAINSBY¹ has proposed a method for the determination of linoleic acid in edible fats consisting in the oxidation of the fat in

anhydrous acetone with potassium permanganate followed by titration of the acidic glycerides after removal of the volatile acidic products by distillation. Kartha and Menon,² in the course of the development of their method for glyceride estimation, considered the possibility of estimating azealo-glycerides by means of their acid values, but preferred saponification values, in order to avoid hydrolysis of azealo-glycerides during titration with alkali. Kartha and Menon have been engaged in effecting further improvements and are now engaged in work with synthetic glycerides. Although their work in this direction has not yet reached publication level, the appearance of Stainsby's paper makes it necessary to publish this note.

We have applied Stainsby's method to one of our synthetic glycerides containing oleic and linoleic acids only. It contains 39.98% of linoleic acid on the basis of iodine value, further confirmed by quantitative estimation as tetrabromide after regeneration of the free acids by hydrolysis. Three separate experiments under identical conditions gave the values 58.5%, 51.5% and 54.2% by the Stainsby method. This method has not proved satisfactory in our hands.

Kartha and Menon's distrust of acid values in glyceride estimation is being further confirmed in our laboratories. We have reasons to suspect a not negligible amount of hydrolysis of azealo-glycerides even during the course of acetone-permanganate oxidation. This difficulty can be overcome and the details of our work in all directions will constitute papers to be submitted for publication elsewhere.

Maharaja's College,
Ernakulam,
December 23, 1948.
A. R. S. KARTHA.
K. N. MENON.
P. S. RAMAN.

1. Analyst, 1948, 73, 429. 2. Proc. Ind. Acad. Sci., 1943, 17, 114.

CHOLERA THROUGH NIRA

DURING the course of an investigation on the susceptibility of certain foods and drinks to contamination with and suitability for the growth and distribution of some intestinal pathogenic bacteria,^{1,2,3} it occurred to us that similar studies with regard to *nira* would be of interest and of considerable importance from the public health standpoint inasmuch as this drink is being popularized as a healthful drink for man. Accordingly *nira* was tested for its suitability for the growth and viability of *E. typhosa*, *S. paratyphi*, *S. schottmuelleri*, *S. enteritidis*, *S. dysenteriae* (Shiga), *S. paradyseae* (Flexner), *E. coli* and *V. cholerae*.

Nira was examined in its non-sterile, steam-sterilized and filter sterilized states and the methods employed in its examination were much the same as outlined previously² with this difference that in this instance *nira* was employed in three dilutions only, viz., 33%, 66% and in an undiluted form, and the tests for multiplication and viability were followed every half an hour instead of every three hours.

The results obtained indicate that, with the exception of the dysentery bacilli, all the other bacteria tested can not only multiply in *nira* but can actually remain viable for 1 to 3 days or longer depending on the dilution and the sterility status of the samples as well as on the nature of the inoculated species. Alcohol formation in the non-sterile samples was, however, observed to have a deleterious effect on the growth, viability, motility, antigenic character and pathogenicity of the bacteria studied. But so far as the *V. cholerae* was concerned, it was observed that in the initial stages of its growth it could even suppress the growth of the indigenous flora of *nira* and that its activity or character was not at all influenced by the production of small quantities of alcohol. In other words, there were unmistakable experimental evidences to suggest that the contamination of *nira* with the cholera vibrio would result in its multiplication with the consequence that contaminated *nira* or for that matter even *oldy* (fermented *nira*) would constitute a menace from the cholera infection view-point.

A detailed report on this subject will be sent for publication elsewhere. In the meantime it must be reported here for the information of the epidemiologist that during last December twenty persons were diagnosed to be suffering from cholera as a result of drinking contaminated *nira* from a newly opened centre in Poona. It is also significant to refer here that eleven of the people taken ill had later succumbed to the infection.

Microbiology Dept., J. V. BHAT.
St. Xavier's College, RODA N. REPORTER.
Bombay,
January 10, 1949.

1. Bhat, J. V., and Raghunath, M., *Curr. Sci.*, 1948, 17, 213 and 284. 2. Bhat, J. V., and Reporter, R. N., *Curr. Sci.*, 1948, 17, 183. 3. Reporter, R. N., "Suitability of certain foods and drinks for the growth and distribution of some intestinal pathogenic bacteria," M. Sc. Thesis, Bomb. Univ., 1944.

THE GROWTH RINGS ON THE OTOLITHS OF THE OIL SARDINE, *SARDINELLA LONGICEPS* CUV. AND VAL.*

THE importance of the study of growth rings on the otoliths and scales of fishes for age determination, by which alone the passage of year classes of commercially important fishes can be followed through the fishery, appears to have been well realized in European countries where intensive investigations on these structures have been made for several years. In India, however, judging by the paucity of investigations in this field, very little attention appears to have been devoted to the determination of age of even the economically more important fishes. The observations of Rad (1935) and Sastry (1936) on the otoliths of *Psettodes erumei*; of Hornell and Nayudu (1923) and Devanesan (1943) on the growth rings on the scales of *Sardinella longiceps*, and of Chacko, Zobairi and Krishnamurthi (1948).

on the radii (circuli ?) of the scales of Hilsa ilisha may be mentioned in this connection.

Hornell and Nayudu¹ were the first in India to detect the presence of growth rings on the scales of the oil sardine and to conclude that

maturity and adult size of 15 cm. at the end of one year, the growth becoming extremely slow thereafter. In the course of a detailed study of the scales, Devanesan has noted the first growth ring on the scales of young oil sardines



Photomicrographs 1-5

1. Right otolith of *Sardinella longiceps* showing one growth ring. $\times 16$. (128 mm., gonads undeveloped, 25th November 1948.)
2. Right otolith of *Sardinella longiceps* showing one growth ring and a wide second growth zone. $\times 16$. (150 mm., immature male 29th November 1948.)
3. Right otolith of *Sardinella longiceps* showing two growth rings. $\times 16$. (195 mm., female, 31st July 1948.)
4. Right otolith of *Sardinella longiceps* showing three growth rings. $\times 16$. (203 mm., male, 19th October 1948.)
5. Right otolith of *Sardinella longiceps* showing two growth rings and false rings (F). $\times 16$. (195 mm., female, 19th October 1948.)

they are formed when growth ceases with the scarcity of planktonic food, and that its longevity is limited to two and a half years. According to them the oil sardine attains sexual

maturity of 6.5 cm. in length and six of them in fish of 8.7 cm. and suggested that nine and fourteen growth rings may be expected to be present in fishes of 15 and 18 cm. size groups respectively.

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It appears probable that he has included the false rings also in his counts, which could be distinguished from the true rings by the characteristics given by Walford and Mosher (1943) for the Californian sardine, *Sardinops caerulea*. The conclusions of these authors, therefore, are so widely different that the span of life of the oil sardine, which ranks as the best known commercial fish of this country has been in doubt.

In view of the prevailing contradictory opinions on the age of the oil sardine, as judged by the study of the scales, special attention was given to the study of otoliths and scales, particularly to the former to determine their value in age determination. Contrary to the statement made by Hornell and Nayudu that "no definite lines of growth can be made out even when the otoliths are ground to thin flakes," the presence of distinct periodical growth rings has now been detected on the otoliths of the oil sardine. These rings can be made out faintly even in wet otoliths immediately after removal from the fish, but they become more pronounced after treatment in the following manner. They are subjected to upgrading in different strengths of alcohol, drying, treating with xylol and mounting in Canada balsam on slides, provided with a circular piece of Bristol board having two punched circular holes, in each of which an otolith is placed. It may be mentioned here that when the otoliths are in alcohol and xylol, the white opacity of the growth zones and the translucency of the growth rings respectively become more pronounced. The degree of opacity of the growth zones can be easily controlled by varying the period for which the otoliths remain in alcohol. Such preparations, when viewed under the low power of the binocular microscope with reflected light, show the growth rings as translucent dark zones concentric with the margin of the otolith, while the intervening growth zones appear opaque white. The photomicrographs of otoliths reproduced here are taken with reflected light and show clearly the first, the second and the third growth rings. Sometimes false rings also appear, but these could be easily distinguished by their line-like appearance and tendency to join a growth ring. Occasionally otoliths fail to show the growth rings for reasons not at present known. In the majority of the otolith preparations only the first and the second growth rings are seen and in a few preparations the third ring is also seen at the posterior broad end of the otolith. My study of the otoliths of the oil sardine inclines me to the view that these rings are formed annually, probably during December to April when scarcity of planktonic food has been noted by Hornell and Nayudu, and that the average life of the fish is about three years. Judging from the size of the fish, the number of growth rings and the width of the last growth zone on the otoliths, it can be stated that the size at maturity, of 15 cm., is reached when the oil sardines are about two years old.

A detailed account of these investigations will be published elsewhere.

My thanks are due to Dr. H. Srinivasa Rao and Dr. B. S. Shimachar for their kind encouragement and discussion on the subject.

Central Marine Fisheries R. VELAPPAN NAIR,
Research Station,
West Hill, Calicut,
December 20, 1948.

1. Chacko, P. I., Zohairi, A. R. K., and Krishnamurthy, B., *Curr. Sci.*, 1948, **17**, 5, 138-39 2. Devanesan, D. W., *Mad. Fish. Bull.*, 1943, **29**, 1-38. 3. Hornell, J., and Nayudu, M. R., *Mad. Fish. Bull.*, 1923, **17**, 129-87. 4. Rio S. R., *Proc. 22nd Indian Sci. Congr., Calcutta*, 1935, 319. (Abstract). 5. Nastry, N. S., *Mad. Univ. Journ.*, 1936, **8**, 200-217. 6. Walford, L. A., and Mosher, K. H., *U.S. Fish and Wildlife Service, Spec. Sci. Rep.*, 1943, **20**, 1-19 (Mimeo.).

* Published with the permission of the Chief Research Officer, Central Marine Fisheries Research Station, Madras.

ON THE OCCURRENCE OF THE 'MRIGAL'. *CIRRHINA MRIGALA* (HAMILTON) IN THE RIVER GODAVARI*

THE 'Mrigal', *Cirrhina mrigala* (Hamilton), is one of the major Indian carps that is extensively used for cultural purposes in central and northern India. According to Day¹ the 'Mrigal' is common in "Rivers and tanks in Bengal, Deccan, N.W. Province, Punjab, Sind, Cutch and Burma, growing to 3 feet in length. It is an excellent species for stocking tanks with".

When engaged on an investigational tour in Rajahmundry during December 1947, two fingerlings of *C. mrigala*,† each about 8 inches long, were collected from the river Godavari, at the Dhoulaiswaram anicut. Enquiries then made of the local fishermen indicated that the fish, which is locally called 'Yerramenu', is rather common in the river system. Since the occurrence of the 'Mrigal' in the Godavari was hitherto unknown, an attempt was made in February 1948, to check up the reported availability, and the Godavari system was surveyed from Rajahmundry to Kotipalli.‡

The fish was fairly common in the local fish markets, being caught from the river as well as the connected tank system, and was highly esteemed. Enquiries revealed that 'Yerramenu' (Red-skinned fish) has been available in the Godavari for the past several years, like Catla or Labeo. Local fishermen have seen specimens measuring 3 feet in length, but the largest specimen in the present collection is only 2 feet long. Fingerlings, 5 to 8 inches in length, were available in the Ramachandrapuram tanks and were transported to Madras for rearing. Large, oozing specimens were found commonly caught in the Rangoon nets and the large drag nets at Bobberlanka and Kotipalli, during July 1948.

The survey thus definitely confirms the reported occurrence of *C. mrigala* in the river Godavari. The facts that *C. mrigala*

(*Yerramenu*) has been familiar to the Godavari fishermen even from their childhood and that the species now yields an important fishery, both in the river as well as in the connected tank system, strongly indicate that it has been naturally occurring in the Godavari all these years but was probably not so common as to attract attention, particularly since the belief hitherto has been that it does not occur in the Godavari.

Spence and Prater² dealing with the game fishes of Bombay, Deccan and the neighbouring districts state that all the species of *Cirrhina* listed by Day are found in the Deccan streams. However, the exact locality of Day's specimens of *C. mrigala* from the Deccan is not clear and so far as I am aware, the species is not known to occur in the Godavari, the Kistna or the Cauvery rivers. Dr. Rahimullah who has carried out an extensive survey of the fishery resources of the Hyderabad State informs me ¶ that "Cirrhina mrigala has not yet been found in the Hyderabad State" and that so far as he knew "It is a fish which is not found south of Narbadda river".

The knowledge of the occurrence of *C. mrigala* in the river Godavari not only extends the range of distribution of the species southwards, but is also of considerable significance in furthering the culture of this carp in South India. Since 1943 the Madras Government Fisheries has been carrying out large-scale long distance transport of fry and fingerlings of *C. mrigala* and *Labeo rohita* from Bengal, with a view to establishing these prime food fishes in peninsular India.³ The attempts proved successful and these semi-exotic carps have been growing well in the departmental farm ponds and other controlled waters, but sufficient numbers have not yet been available for any large-scale planting in the rivers⁴. The availability of the 'Mrigal' in the Godavari makes transport of valuable seed of this wholesome carp to the rivers and tanks in the far south, obviously much easier and less expensive than transporting them all the way from Bengal or Orissa.

Freshwater Bio. Res. Stn., K. H. ALIKUNHI.
Government Fisheries, Madras,
October 23, 1948.

* Published with the kind permission of the Director of Industries and Commerce, Madras.

† My thanks are due to Dr. S. L. Hora for kindly confirming my identification.

‡ I am indebted to Messrs. S. Nagaraja Rao, S. H. Hussainy and D. L. Dikshetherlu, of the Madras Fisheries, for carrying out the survey and arranging to transport a consignment of live fingerlings to Madras.

¶ Personal communication to the author.

1. Day, F.: *Fauna of British India*, 1889.
2. Spence, R., and Prater, S. H., "Game Fishes of Bombay, the Deccan and the Neighbouring Districts of the Bombay Presidency," *Jour. Bombay Nat. Hist. Soc.*, 1933, 36, (1). 3. Jagannath, N., "A note on the introduction of Rohu and Mrigal into Madras waters", *Indian Farming*, 1946, 7, (6). 4. A maximum size of 30·6 inches; weighing 16½ pounds, in 3 years, has been attained in the Chetput Fish Farm, Madras,

A MUTANT *CEDRUS DEODARA*, LOUDON

WHILE on an excursion with the East Punjab University Botanical Party led by Dr. P. N. Mehra this year to Mussoorie the writer came across a tree bearing abnormal male cones which it is thought worthwhile to place on record.

The normal male cone in *Cedrus Deodara* is erect, solitary, cylindrical-ovoid and is about 1½ inches long (Photo 1). There is a single ring of vascular bundles in the cone-axis.

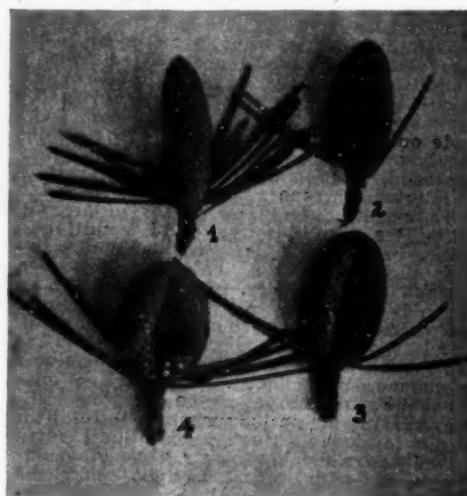


FIG. 1

On this tree there were borne almost exclusively what apparently looked like double male cones. A closer examination, however, showed that the cones are really single but while still young the cone-axis undergoes longitudinal fission. During further growth the two halves are outwards while still remaining united at the base and apex. At first therefore a depression appears in the centre (Photo 2) but later as the cone matures the two halves bend outwards so as to leave a gap in the middle giving a markedly double appearance (Photo 3 & 4). A transverse section through cone-axis in such cones shows the two halves of the cone-axis separate, each semicircular in outline and with its own half ring of vascular bundles. The cells at the region of the split turn brownish and develop relatively thicker walls.

To the writer's knowledge this variation has not so far been recorded in this species.

Pharmacognosy Department,
East Punjab University,
Amritsar,
November 19, 1948.

T. N. KHOSHOO.

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SMUT ON THE MAT-SEDGE, CYPERUS PANGOREI, ROTTB.

Cyperus pangorei, Rottb.¹ (syn. *C. corymbosus*, Rottb.) is a smooth rush-like sedge growing in marshy places to a height of two to three feet, and used in South India and Ceylon for mat making. Smut appeared in a plot of this sedge in the laboratory garden in Bangalore towards the end of October 1948. The infection was at the bases of the peduncles and in the spikelets (Figs. 1 and 2). A reference to the literature showed a record of



FIG. 1. Two inflorescences of *Cyperus pangorei* showing typical smut infection.

FIG. 2. Sori at the base of peduncles, and left-hand figure showing infection of the spikelets.

FIG. 3. Infection of the ovary. Divisions of scale - 1/50 inch.

Cintractia peribebuyensis Speg. in the peduncles only of *Cyperus* sp. from several localities in India. Sydow, H. and P., and E. J. Butler¹ recorded it first from specimens of *Cyperus* sp. collected by Butler at Bilikere, Mysore on 19th September 1903. Butler and Bisby,² and Uppal, Patel and Kamat³ repeat the mention of this fungus without any additions or an

identification of the species of the host. The same fungus is recorded by Petch⁴ as occurring on *Cyperus distans* L. f. collected by C. Drieberg in September 1903 in Ceylon. The fungus was originally described by De-Toni⁵ as *Ustilago peribebuyensis* Speg. in peduncles of *Cyperus* sp. from Paraguay. *Cintractia* differs from *Ustilago* in the spores remaining firmly agglutinated and compact for a long time, the central columella of plant tissue, and the development of the spores from inside outwards.

Microscopic examination confirmed that it was a *Cintractia*. A transverse section through the base of the affected spikelet showed a central core of plant tissue consisting of fibro-vascular and parenchymatous tissue. The younger spores were at the base passing out into mature spores which constitute a dense dark agglutinated layer. The stroma gives rise to dark brown strands of hyphae, with the fertile hyphae in between forming small pockets or clear compartments of spores which are at first pale, and later become dark and mature. The sori are present at the base of the peduncles forming swellings first covered by a whitish false membrane (Fig. 2), which soon ruptures exposing the dark-coloured spore masses. The sori occur on the spikelets, also involving the rachilla and all portions of the flowers except the glumes, anthers, and styles (Fig. 2). The sori in the spikelets are also covered by a whitish false membrane which ruptures to expose the dark spores. The ovaries are transformed into smut sori, but the styles are unaffected, and may be seen sticking out from the tip of the sorus (Fig. 3). The spores are oblong to roundish and agree in measurements with those given by De-Toni for *Ustilago peribebuyensis*, Speg., viz., 12–13 × 8–9 μ .

Several species of *Cintractia* are known to produce their sori in the ovaries of their hosts, but species affecting both peduncles and spikelets are few. According to Mc Alpine⁶ *C. densa* on *Rottboellia compressa* infects both the rachis and florets, while *C. exserta* on *Anthistiria ciliata*, and *C. spinificis* on *Spinifex hirsutus* infect the spikelets, the latter destroying the ovaries also. In the absence of information on the exact species on which *C. peribebuyensis*, Speg. has been recorded in India, this is the first record of the fungus on *Cyperus pangorei*, Rottb. on the peduncles and spikelets.

Plant Pathology Sect.,
Dept. of Agriculture, S. V. VENKATARAYAN,
Bangalore,
December 1, 1948.

* I am indebted to Sri. S. N. Chandrasekhara Iyer, Government Lecturing and Systematic Botanist, Agricultural College and Research Institute, Coimbatore, for the identification of the host plant.

- 1 Sydow, H., and P., and E. J. Butler, "Fungi Indiae orientalis Part I," *Ann. Mycol.*, 1906, 4, 427.
- 2 Butler, E. J., and G. R. Bisby, *The Fungi of India, Sr. Mon.* 1, *Imp. Coun. Agr. Res.*, 1931.
- 3 Uppal, B. N., M. K. Patel, and M. N. Kamat, *The Fungi of Bombay, Bull.* 176 of 1934, *Dep. Agr. Bombay*, 1935.
- 4 Petch, T., "Ustilagineae and Uredineae of Ceylon," *Ann. Roy. Bot. Gard. Perad.*, 1912, 5, Pt. 4, 226.
- 5 De-Toni, J. B., in Sacardo, P. A., *Sylloge Fungorum*, 1888, 7, 458.
- 6 McAlpine, D., *The Smuts of Australia*, *Dept. Agr. Victoria*, 1910.

SEX REVERSAL (HETEROGAMY) IN THE JACK-FRUIT TREE, (*ARTOCARPUS INTEGRIFOLIA*, LINN.)

THE flowers of the jack-fruit tree (*Artocarpus integrifolia*, Linn.) are usually monoecious, on uni-sexual, axillary pedunculate receptacles. An abnormal inflorescence was noticed in a tree in Bangalore in September 1947. On the male receptacle, with the male flowers extending over a length of about two and a half inches, the female flowers developed on a side at the base for a distance of 0.8 inch in the linear axis, and 0.9 inch across (Fig. 2). Later in September 1948, the same tree bore on a branch, on the fourth receptacle from the tip a similar abnormal inflorescence (Fig. 1).

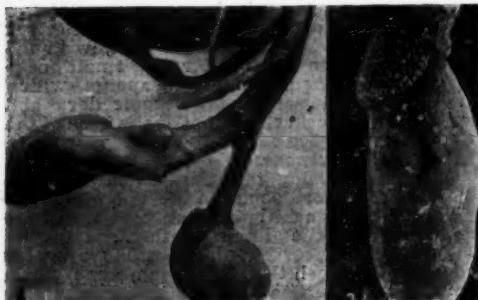


FIG. 1

The female flowers had pushed the male receptacle to a side by their growth. The male axis was about three inches long, by an inch and a half thick, while the female axis was also three inches long, and nearly two inches across. This kind of a change in the arrangement of the male and female flowers is known as heterogamy.

Instances of reversal in arrangement of flowers or the sexual organs have been observed. According to Masters¹ and several others in the cultivated maize, now and then one finds examples in which the sexes are mixed in one and the same inflorescence, the tassels which usually contain only male flowers sometimes bear female flowers (tassel seed). In the same manner but more rarely, the female inflorescences occasionally bear the male flowers (anther ear). Masters¹ states that in hops (*Humulus lupulus*) and *Urtica dioica*, the usually dioecious condition is sometimes changed into a monoecious condition with the female catkins at the end of the branch, and the male catkins below. Frank² has observed that in *Salix babylonica*, the weeping willow, there is a transformation of the stamens into pistils, and the pistils into stamens. A similar transformation has been observed by Cecil Yampolsky in *Mercurialis annua* (Robbins and Pearson³). Frank² states that in *Cirripus betulus*, some stamens occur in the female flowers. According to Robbins and Pearson³, the late Prof. Rosa found in some strains of

spinach, "a considerable portion of the plants, purely pistillate in the early part of their flowering period, produce, later in the season, some staminate flowers towards the tip of the branches, especially of small lateral branches." Robbins and Pearson state that Cecil Yampolsky obtained in male plants of *Mercurialis annua*, stray female flowers some of which bore seeds, and the seeds produced all males.

These different sex conditions are supposed to be caused by factors definitely known to be located in the chromosomes. Some of these are known to produce, in maize, partial or total sterility or to modify the expression of either the staminate or the pistillate inflorescence or both.

The sexual forms of flowers have been found to vary with the changing conditions, within and around the plant, and often with the time of the year. Robbins and Pearson³ report an interesting case of change in physiological conditions causing a change in sex of flowers in the Hawaiian Islands, "where some one cut off a male papaya tree, and the new shoots which came up from the stump were all female!" Schaffner⁴ succeeded in obtaining sweet corn plants whose tassels showed reversal to the pistillate condition by shortening the length of day; the ratio of sex reversal was inversely proportional to the length of the daylight. Little or no reversal occurred with equal day and night periods. He concluded that the sex-reversal might be independent of any sex-determining factors. It is well known, however, that genetic factors do come into play, but that they may be influenced by the environment.

Some fungi are known to cause the development of dormant or rudimentary structures and to induce the growth of entirely new organs. According to Butler,⁵ stamens that normally are rudimentary in the pistillate flowers of *Lychnis* (*Melandryum*) *dioica*, when attacked by anther smut (*Ustilago violacea*) in Europe, grow to full size, but only produce smut spores instead of the pollen grains, and buffalo grass (*Buchloe dactyloides*) may form ovaries in its staminate flowers when parasitized by the smut fungus, *Tilletia buchlegae* in America.

According to Baker⁶ recent observations by Love, A., and Love, D., have shown that the development of stamens in pistillate plants of *Lychnis* (*Melandrium*) may be brought about by treatment of plants with the animal hormone testosterone, while the reverse change has been caused by oestrone. Baker notes that when such change occurs some secondary sexual characters also develop, but other characters persist, because they are sex-linked. Infection by the smut or the application of testosterone can promote the formation of stamens, and suppress the formation of pistils.

Rhizopus artocarpi is a common fungus on the male inflorescences of the jack-tree, but the infected receptacles soon drop down. Apparently this infection cannot bring about the sex-reversal. The abnormal inflorescence was noticed to be infested with some mealy bugs, though not in large numbers (Fig. 2). The tree was subject to frequent cutting off

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of the lower branches accidentally or intentionally, and it is possible that this or the cumulative effect of all the adverse factors may have brought about the reversal of sex.

Plant Pathology Section,
Dept. of Agriculture, S. V. VENKATARAYAN.
Bangalore,
December 1, 1948.

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4. Schaffner, J. H., "Control of Sex Reversal in the Tassel of Indian Corn," *Bot. Gaz.*, 1927, 84, 440-49.
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A NOTE ON THE AMPHIDIPOLOID OF THE HYBRID OF *PENNISETUM TYPHOIDES* STAPF. AND HUBBARD X *P. PURPUREUM* SCHUMACH.

BURTON¹ (1942) obtained the interspecific hybrids of *P. glaucum* (L.) R. Br. (syn. *P. typhoides*. Stapf. and Hubbard.—the pearl millet) and *P. purpureum* Schumach. the Napier or the elephant grass used as the female parent. He obtained chlorophyll variations even in the *F*₁s, viz., green and yellowish green types. The hybrids were triploid and highly sterile. On back crossing the *F*₁s, to both parents (used as pollen parents) he obtained one plant out of 5,000 spikelets sown in each case.

In 1942 the senior author obtained independently, hybrids using a male-sterile pearl millet plant as the female parent. The hybrids showed chlorophyll and vigour differences similar to Burton's observations. Since then it has been found that *F*₁s, are easily produced whichever the stigma parent may be whether the diploid or the tetraploid species. However, having the cultivated, diploid as the female parent has its advantages in that the spikelets are not shed and the hybrid plants are easily recognised.

Since obtaining the hybrid attempts were constantly made to induce doubling of the number of chromosomes in the hybrid plant. Treatments of the seeds or the seedlings with aqueous solutions of 0.4% colchicine were not successful. The retardation of growth in the roots and shoots induced by colchicine treatment caused the ultimate death of the treated material. When it was realised that the cuttings of the stems of three internodal lengths could easily be made to strike root and the hybrid thus propagated, recourse was taken to treat the axillary buds with colchicine. The sets when planted in water produced an abundance of roots and the bud started growth.

These active axillary buds were chosen for treatment. The scale leaves were removed and the growing point exposed to a safe limit by removing the young sheathing leaves around it. The buds were then treated with 0.4% colchicine emulsion in lanolin for nearly a

week. Treatments with aqueous solutions were also done. The sets were then transplanted into pots and thence into the field. Other kinds of treatments like injection of the fluid into the sheath near about the growing point with a hypodermic syringe, treatment with acenaphthene all failed. Out of a dozen sets treated and transplanted one set alone showed tillers with complete fertility in the panicles. In this set out of the three buds treated only one has become affected while the other two have remained unaffected (Fig. 6).



1. *Pennisetum typhoides* diploid, $\times 1/20$; 2. *P. purpureum*, tetraploid, $\times 1/40$; 3. *F*₁, triploid, $\times 1/40$; 4. *F*₂-1 hexaploid $\times 1/30$; 5. *F*₂-2, $\times 1/30$; 6. C-induced amphidiploid the right-hand clump. The left-hand clump is not affected. $\times 1/50$ nat. sizes.

Simultaneously a large quantity of the mature spikelets from the hybrids was sown. From them three seedlings were obtained of which two survived. Seedling *F*₂-1 is more vigorous than the *F*₂-2 and has broader and longer leaves (Figs. 4 and 5). In the appearance of the vegetative parts both resemble more the pearl millet than the elephant grass. The stems are softer, not woody and the nodal adventitious roots dormant as in the pearl millet. The two plants produced panicles, thin with long bristles, fewer and more distantly arranged spikelets resembling those of the elephant grass. The flowers are protogynous. The emergence of the stamens, however, is as in the pearl millet. The pollen treated with iodine showed high fertility in contrast to the hybrid plant. The *F*₂-2 has very low vigour and slower growth. Consequently the examination of the root tips of this plant has been deferred till it picks up more strength,

TABLE I

Plant	Veg. characters (Perennial or not, rhizomatous or not)	Leaves coriaceous and hairy	Anther emergence	Ht. of plant in cm.	Pollen diameter in μ	Fertility %	Chromo- some num- bers $2n$. ($x = 7$)
<i>P. typhoides</i> ♀ parent	Annual. Non rhizo- matous	Somewhat coria- ceous very sparsely hairy	In full flush	270	39.18	98.6	14
<i>P. purpureum</i> ♂ parent	Perennial Rhizoma- tous	Coriaceous, hairy	Slow, not in full flush	420	42.46	95.9	28
Hybrid F ₁	Perennial. Non- rhizomatous	Intermediate, hairy	Slow in flush, sterile	420	34.43	1.6	21
F ₂ -1	Probably perennial, Non-rhizomatous? Like mother	Like mother	Full flush	283	69.01	92.8	42
F ₂ -2	do	Like mother. Leaves narrow	do	283	56.2	74.0	c. 35
C-induced fertile shoots	Probably perennial. Like male parent	Like F ₁ , shorter and broader	Full flush	430	69.01	92.8	42

The F₂-1 has shown 42 chromosomes in the somatic cells.

The bud that showed colchicine effect has produced about ten shoots. The vigour of these shoots is slightly more than that of the shoots from the unaffected buds. The stems are thick and woody. The peculiar growth habit of the elephant grass with sugarcane-like appearance and the older stems becoming woody with adventitious roots developing from the nodes is continued in the induced shoots, while in the seedling F₂s, this habit is absent and the stems are more tender. The leaves are somewhat shorter and broader. The panicles in appearance are like that of the elephant grass. The emergence of the anthers is in a flush as in the pearl millet and the fertile pollen is formed in plenty. The pollen mother-cells of this plant were examined cursorily in iron-acetocarmine and it was found that the chromosome number was $2n=42$, showing that doubling had taken place.

P. typhoides is diploid with 14 somatic chromosomes (Fig. 1). The Napier or the elephant grass has two types (1) with anthers emerging slow and thinly arranged spikelets (Fig. 2), and (2) with anthers emerging in a flush and closely arranged spikelets. Both have the same chromosome number, viz., $2n=28$. The first type was used as the male parent in the hybrid reported here. Thus *P. purpureum* is a tetraploid species. The hybrid is triploid with $2n=21$ (Fig. 3). The cytogenetical behaviour of the two amphidiploids and their progeny would be highly interesting since the induced one differs greatly from the one obtained from the F₂, and the F₁, shows pairing affinities between the *P. typhoides* and the *P. purpureum* genomes. The F₂ plants also show multivalent formations in the P.M. Cells. The behaviours of some of the prominent characters are summarised in Table I above.

The detailed cytological behaviour of these plants are being studied. Hybridizations between the $2n$ and $6n$ plants and also between the different *Pennisetum* species are being done. In the F₂-2 a rough examination of the P.M. Cs. showed multivalent formation and the exact numbers of chromosomes will be reported elsewhere after its determination, in the root tips.

It is suggested that the amphidiploid may be named as *Pennisetum purpureotyphoides*.

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Lawley Road P.O.,
December 11, 1948.

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ANGULAR LEAF-SPOT OF KUDZU IN MYSORE

A *Cercospora* leaf-spot disease of kudzu (*Pueraria thunbergiana* Benth.) was observed in Bangalore, South India, on some of the plants grown for experimental purposes. Kudzu is a leguminous cover crop introduced in Bangalore from imported seeds. The fungus incited severe spotting of the leaves and hastened defoliation. Young lesions were light brown and gradually widened into dark-brown angular spots. When large areas were involved, the leaves dropped off.

Similar angular spots of kudzu causing severe damage in Georgia, United States, was recently reported by Weimer and Luttrell² as due to *Mycosphaerella Pueraricola* (Yamamoto) Weimer and Luttrell. Its conidial stage *Cercospora Pueraricola* Yamamoto was first recorded in Formosa (Yamamoto³) and

later in China (Tai¹). It has not so far been recorded from any other place in the Orient. *C. Puerariae* Syd. reported from the Philippines on *Pueraria Phaseoli* is a different species. Weimer and Luttrell assume that *Myco-sphaerella Pueraricola* has been introduced into the United States along with kudzu seeds imported from Japan.

Microscopic studies of the diseased kudzu leaves collected in Bangalore, revealed the tufts of conidiophores arising from the pseudoparenchymatic stroma. They were amphigenous, but mostly hypophyllous, simple, olive-brown, 1-6 septate, $85-180 \times 3-5-4-5 \mu$. Conidia were hyaline, obclavate to cylindric, filiform at the apex, up to 15-septate, $85-170 \times 3-3-5 \mu$. The conidia and the conidiophores were therefore slightly larger than the measurements given by Weimer and Luttrell for *M. Pueraricola* (conidiophores $20-84 \times 4-4-5 \mu$, conidia $25-2-128 \times 3-5-3 \mu$).

The present record of *Cercospora* on kudzu plants in Bangalore grown from imported seeds is of interest since no *Cercospora* species is known on kudzu or *Pueraria tuberosa* DC. the only indigenous species known in South India. Care should be exercised in preventing the spread of the disease if large-scale cultivation of kudzu is undertaken.

Bangalore,
December 15, 1942.
M. J. THIRUMALACHAR.

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PRODUCTION OF THYMOL FROM AJOWAN SEEDS

AJOWAN oil distilled from the seeds of an umbelliferous plant, the ptychosis ajowan (*Carum Copticum*), is an important source of thymol in India.

A general survey of the oil content of the ajowan seeds gathered from the villages of Punjab is made in this laboratory. Steam distillation of the coarsely ground seeds is best for the extraction of the oil.¹ Treatment of the coarsely ground seeds with solutions of different concentrations of alkalis or salts followed by steam distillation lowers the yield of the oil.

Iklas seeds give a maximum average yield of 4.2% of oil on the weight of the seeds.

Thymol in ajowan oil is estimated by its conversion into iodo-derivative and titrating the excess of iodine.² The oil from the seeds of Iklas and Sabazpur contain respectively 39.3% and 36.2% thymol on the weight of the oil. Method of Dodge³ presents difficulties due to the formation of stable emulsions.

EXTRACTION OF AJOWAN OIL

TABLE I

Method: Steam distillation. 100 gms. of coarsely ground seeds used in each distillation

Distillation	Locality of seeds	Yield of oil in gms.	Colour of the oil
1	Nagawali	2.85	Light yellow
2	"	2.90	"
3	Pindighels	3.63	Golden yellow
4	"	3.53	"
5	Domeli	3.97	Light brown
6	"	3.83	"
7	Sabazpur	4.18	Light yellow
8	"	4.13	"
9	Iklas	4.15	"
10	"	4.23	"

TABLE II

Method: Steam distillation. 100 gms. of coarsely ground Iklas seeds used in each case after treatment with alkali or salt

Distillation	Treatment	Yield of oil in gms.	Colour of the oil
1	Kept 8 hrs. with 500 c.c. 5% NaOH	0.5	Light brown
2	" " 1% NaOH	1.01	Brown
3	" " 2N NaOH	1.53	"
4	" " 5N KNO ₃	2.23	"

According to Chopra and Mukherjee⁴ the seeds from different parts of the country yielded varying proportions of oil ranging from 2.0 to 3.5%. Seeds obtained from the Kurnool-Guntakal district of Madras Presidency appeared to be the best obtainable in India. These seeds gave a high yield of oil, i.e., 3.5%. The seeds obtained from Northern India yielded only 2.97% of the oil, and the percentage of thymol in most of the Indian oils is not more than 33 to 37%.⁴ This publication is delayed due to the political changes at Lahore.

Technical Chem. Laboratory,
Forman Christian College, JAMES VERGHESE.
Lahore, K. C. GULATI.
November 25, 1948. M. L. JOSHI.

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WOODEN PANS FOR SUGARCANE SEEDLINGS

In the September (1948) issue of the *Current Science*, Dutt, Rao and Davis reported a better output, growth and uniformity of sugarcane seedlings grown in glazed clay pans as compared to country-made earthenware pans. Our own experience with earthen pans in the Co. S. seedling work at Shahjahanpur was similar to that of the Coimbatore workers, but we have changed over to wooden pans, which we find very satisfactory. Pans made of deal-wood were first tried by Dr. A. K. Mitra in 1942 for replacing some of the earthen pans broken in handling; these dealwood pans were found so promising that the writer made a complete change over to pans made of *Sal-wood* (*Shorea robusta* Gaertn.) in 1945; and our past four years' experience with the latter has more than justified the change from earthenware to wood. Our *Sal-wood* pans compare favourably with earthen pans (and presumably with glazed pans also), as may be seen from the statement below:-

	Truncated conical earthen pans	Square box- shaped wooden pans
Cross dimensions at top and outer edge ..	13 in.	12 in.
Cross dimensions at soil surface ..	11 in.	11 in.
Approx. weight per pan ..	9½ lb.	7½ lb.
Approx. area of soil surface per pan, available for sowing fluff ..	95 sq. in.	121 sq. in.
Approx. vol. of soil contained per pan ..	372 c. in.	635 c. in.

It will be seen from the above that, pan for pan, (1) wooden pans are 24 per cent. lighter in weight, (2) provide 27 per cent. more soil-surface for fluff and (3) hold 70 per cent. more soil for seedlings than earthen pans. On a given area of bench-space, wooden pans being square in shape with erect sides, provide more soil-surface than the earthen pans, which, being round and due to their sides diverging outwards, consume bench-space needlessly; the walls of wooden pans are also thinner. All said, with a change-over to wooden pans, we were able to effect a substantial increase in seedling output without addition to bench-space. Like glazed pans, these wooden pans also provide a uniform depth of soil for all the seedlings grown in the pan. In addition, wooden pans are easier to handle and breakages are negligible; repairs, if any, are simple and a matter of minutes. The cost as compared to glazed pans is very low (we paid a wartime rate of Rs. 1.12 per pan in 1944), and as there are practically no recurring costs and replacements, the cost of pans per year works out lower than with even country-made earthen pans. As is well known, *Sal-wood* does not rot through prolonged contact with water as other woods do, and a mere coating of coal-tar has been sufficient to keep off termites. We could have employed some of the new termite-fuges

in the market, but this has not been found necessary here. As may be seen from the photograph, seedlings come up very well in these wooden pans, and in the writer's opinion,



wooden pans are better in every way than country-made earthen pans or factory-made glazed clay pans.

As regards the health and growth of seedlings, our experience is that the quantity of fluff sown per pan has a greater effect on the condition of the seedlings than the shape of the pan or the material of which it is made. At first we were also using 2 gm. of fluff per pan, but as the seedlings came up weakly and were rather under-developed at transplanting time, we reduced the rate to 1.5 and later to 1 gm. per pan, and this proved advantageous. Now we are sowing only 0.75 gm. of fluff per pan. It is possible, however, that in noble-cane crosses and other hybrid fluff of known low viability, the fluff rate can or should be higher. We had some *Phytophthora* damping off of seedlings, but we overcame this trouble by reducing the fluff-rate per pan and also by sterilizing the soil, which means merely stirring it in sunshine daily for a few days before preparing it for the pans.

As a result of all these improvements, we have not only considerably increased the seedling output, but have also reduced our transplanting mortality markedly. It would perhaps be worthwhile trying wooden pans in place of earthen pans, before changing over to glazed pans.

Sugarcane Research Station, R. R. PANJE.
Shahjahanpur,
November 27, 1948.

SOME OBSERVATIONS ON JUICES OF DISEASED SUGARCANE

It is well known that a considerable drop in juice quality is brought about by cane diseases like red rot (*Colletotrichum falcatum*) and Wilt (*Cephalosporium sacchari*) and the juices of such diseased canes are particularly difficult to clarify both in the vacuum and open pan systems of manufacture. Apart from the fall in sucrose and purity per cent. detailed knowledge in respect of non-sugar ingredients (which largely determine clarifying properties) is singularly lacking, being restricted to some casual observations in the literature such as that made by Kortscher (1939) to the effect that in diseased canes, exceptional quantities of gum are apt to occur.

In this note, some preliminary results of interest in respect of juices from red rot and wilt affected canes, originating from different areas in Bihar are briefly reported. In addition to determinations of Brix, Polarisation and Invert Sugars, the following non-sugar ingredients (important from the technological view-point) were also examined in these studies, in accordance with analytical methods indicated against each:-

Total Colloidal Matter (Kharin and Smirnova, 1936), Gums (Ruff and Withrow, 1922), Pectin (Farnell, 1924), Crude Protein (Total Organic Nitrogen \times 6.25), Ash and Phosphate contents (Pemberton, 1892, 1894).

Although a number of samples from different localities in Bihar was examined, only typical

cases representing a fairly heavy attack of the two diseases have been shown in Table I. It will be evident from the table that besides the losses in sucrose, increases in invert sugar, colloids (total as also of different categories) and ash contents are occasioned by the red rot disease. The same trend is manifested with regard to changes caused by wilt, although to a much smaller extent, in so far as the present investigations appear to indicate. The highly deleterious effect of large quantities of all these ingredients (except phosphate) on the clarifying properties of juices undoubtedly account for most of the milling difficulties experienced. Further work is in progress.

The work was carried out as part of the Sugarcane Research Scheme in Bihar being financed jointly by the Government of Bihar and the Indian Central Sugarcane Committee, to whom grateful thanks are due. The assistance rendered by M. S. A. Rifay, Sugarcane Pathologist, in supplying samples of material is also acknowledged.

**Central Sugarcane
Research Station,
Pusa (Bihar).
December 28, 1948.**

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TABLE I

Showing changes in Juice Criteria of Red Rot and Wilt Affected Canes

(s) Red Rot
Variety : Co. 331

(d) Wilt
Variety : Co 385

Sl. No.	Ingredients*	Healthy	Diseased	Per cent change due to disease	Healthy	Diseased	Per cent. change due to disease
1	Brix	19.90	9.50	-52.3	18.40	12.80	-30.4
2	Polarisation	17.58	4.62	-73.7	15.29	7.30	-52.3
3	Purity	88.50	48.60	-45.1	83.10	57.03	-31.4
4	Invert Sugars	2.46	25.47	+93.54	2.50	12.19	+388.8
5	Total Colloids	2.41	11.16	+362.7	6.40	8.61	+34.6
6	Gums	0.27	1.26	+366.1	0.83	1.23	+51.7
7	Calcium Pectate	0.29	0.88	+198.6	0.12	0.16	+36.7
8	Claude Protein	0.53	1.41	+164.5	2.23	3.72	+63.3
9	Ash	2.01	6.53	+224.4	3.72	7.30	+96.4
10	P ₂ O ₅	0.11	0.18	+61.3	0.13	0.19	+49.6

* Ingredients 4 to 10 are expressed as percents on Total solids.

VINCENT MASSEY SCHOLARSHIP

THE Secretary of the Vincent Massey Scholarship Selection Committee informs that the Committee invite applications for the Vincent Massey Scholarship for 1948-49 and 1949-50 of the value of \$2,000 (inclusive of all expenses) which is tenable for one year for post-graduate

work (ordinarily Master's degree) at the University of Toronto. Details about the Scholarship, which is open to all men candidates belonging to India and Pakistan, the Secretary says, can be obtained from him by writing to him at 5. Russell Street, Calcutta 16.

REVIEWS

Oceanic Birds of South America. By Robert Cushman Murphy. 2 Volumes. (The Macmillan Company, New York), 1948. Pp. 1245; 73 photographic plates; 16 colour plates; 80 text illustrations. Price \$17.50.

Robert Cushman Murphy is a name that stands amongst the topmost rungs of the ornithological ladder to-day. He is the distinguished chairman of the Department of Birds in the American Museum of Natural History, New York, and in his own particular sphere recognised amongst the world's foremost authorities. This work, first published by the American Museum of Natural History, New York, in 1936 was hailed as the most exhaustive and outstanding contribution to the subject of oceanic birds and ran out of print within the first few months. It has been greatly desired and sought after by serious bird students throughout the world, and therefore it is particularly gratifying to find that Messrs. Macmillan's have now undertaken to reprint it. The contents, both text and plates—the latter by the well-known bird artist Francis L. Jaques remain unchanged.

At the time the book was written Dr. Murphy was Curator of Oceanic Birds in the New York Museum. He had specialised for many years in the study of sea birds and taken part in many cruises of investigation. His fascinating book "The Bird Islands of Peru" published in 1925, which deals largely with guano and the birds responsible for its production on islands off the Peruvian coast is a record of the greatest value.

The present volumes are based principally on collections made by the Brewster-Sanford Expedition between 1912 and 1917, continued later by the author himself, and supplemented by previous material obtained sporadically and haphazardly at different times by various voyagers and found scattered in many museums. The late Mr. Rollo Beck assisted by his wife who was responsible for the major part of the Brewster-Sanford collections must indeed have been a remarkable man. The collection made by him numbered well over 7,000 specimens, fully representative of the South American sea-bird fauna including most of the truly pelagic forms and also many little-known rarities.

The difficulties of collecting far-ranging ocean birds are obvious. Members of the Procellariiformes—albatrosses, fulmars, shearwaters, petrels, etc.—spend most of the year on the high seas, far from land and are only occasionally blown into coastal waters by storm. They breed on oceanic islands so remote and off the beaten track that many species still have their breeding grounds undiscovered.

To one with any experience of collecting birds, Mr. Beck's proficiency and thoroughness will sound phenomenal. We are told that he often got as many as 40 specimens a day, all prepared with uniform excellence and with complete data concerning soft parts, stomach

contents and field notes in addition to excellent photographs. If he has any experience of collecting sea birds, even in littoral waters, he will realize more readily the magnitude of the successful collector's task, particularly in bad weather. Little wonder then that Dr. Murphy extols Beck as "the most successful worker in this branch of ornithology that the world has known".

To the collections of the Brewster-Sanford Expedition Dr. Murphy added material from South Georgia, the littoral of Peru, Ecuador and Venezuela and the Galapagos archipelago, and supplemented this further by specimens from Fernando Noronha, South Trinidad, St. Helena, Ascension and others, short descriptions of the flora, fauna and avifauna of all of which are furnished. During the preparation of the work the author made an examination of practically all available material of oceanic birds in the museums of the United States and abroad. From this and from the impressive bibliography given at the end may be gleaned some idea of the scope and thoroughness of the information presented in these volumes.

Part I of Vol. I (the first 322 pages) is what makes this book so refreshingly different and so particularly valuable to students, even though their special interest may not lie in the sphere of oceanic birds, or in the region with which it specifically deals.

Among the subjects dealt with, and of rather more general interest, are Meteorology, Hydrology in relation to oceanic birds, the Nutritional Basis of Marine Life, the Zones of Surface Water, and Ocean Currents. The discussion of Birds and Hurricanes (pp. 53-59) and the responsibility of the latter for the fortuitous transportation of sea birds to distant extrazonal areas, and for mortality among them is particularly illuminating.

A detailed account of the Guano industry follows. The chief guano producing bird on the Peruvian islands is the Guanay (a cormorant—*Phalacrocorax bougainvillii*), the next two in importance being the Piquero, a species of Gannet (*Sula variegata*) and the Alcatraz, (a pelican—*Pelecanus occidentalis thagus*). The guano deposits, we learn, are thousands of years old and in some places are, (or were—since they have been ruthlessly exploited) over 20 metres in thickness. The average annual yield from this area is over 100,000 metric tons. When it is realized that guano as a fertilizer is 33 times more effective than farmyard manure, the economic importance of the birds producing it will be truly appreciated. "The wild story of the early years of guano exportation, which Peruvian historians refer to as a 'saturnalia' is not likely to be familiar to many readers to-day" says Dr. Murphy, and the details he gives of the guano-fever which raged about the middle of last century with sordid competition amongst international adventurers and the accompanying "greed and corruption...and dust-gagged misery and slavery" (more fully described

in his "Bird Islands of Peru") make as dismal a commentary on our so-called civilization as any that one can recall of the exploitation by Man of his less fortunate fellows.

Part II—The Oceanic Birds—which commences at p. 323 and runs on through the second volume, contains a systematic account of all the truly Antarctic species including littoral, in-shore, off-shore and pelagic birds. In spite of the enormous collections he was privileged to handle, the author deplores the lack of adequate series of many forms over the entire breeding range of many a genus.

The arrangement and nomenclature followed are those of Peter's 'Checklist of the Birds of the World'. The total number of forms dealt with is 183 contained in 16 families of the Orders Spheniciformes (Penguins), Procellariiformes (Albatrosses, Petrels, etc.), Pelecaniformes (Pelicans, Cormorants, Tropic-Birds, etc.), Anseriformes (Geese and Ducks), Charadriiformes (Oyster-catchers, Skuas, Gulls, Terns, etc.). Each order and each family are suitably introduced. 10 forms of penguin (out of the 17 recognised) are discussed, together with their probable ancestry, and theories about their flightlessness. In Procellariiformes, classification, stomach oil, evolution, nidification, enemies and feeding are aspects exhaustively dealt with, as also are economic status, distributional range, habits and moults, etc.

The so-called Steamer Ducks (*Tachyeres*) have long been a subject of controversy and argument among ornithologists, some maintaining that the flying and non-flying forms were but young and adult phases of a single species, others that they belonged to 2 entirely distinct species. From a critical examination of a large series covering all ages, all seasons, both sexes and the entire range of the genus, Murphy has been enabled to prove (p. 953) that actually not two but three species are concerned : 2 flightless (one confined to the continental littoral, the other to the common Falkland Islands) and one flying, which is common to both these areas.

The author suggests (p. 1101) that although the Arctic Tern *Sterna paradisea-macrura*) has been taken in the Antarctic as far south as 74° S. lat., the belief that it regularly migrates across the world from the Arctic to the Antarctic, making a round trip of 22,000 miles each year may "yet prove to be a far-reaching ornithological illusion". He shows that the very similar Antarctic Tern (*S. vittata*) which is a resident in the Antarctic and breeds on South Orkney Islands and elsewhere, November to January, has largely and often been confused with the Arctic Tern in published southernmost records. If Murphy's well-documented view is correct, we cannot help regretting that one of the most spectacular legends in the realm of bird migration will have been dissipated, thus adding one more victim to the toll that prosaic science is constantly and relentlessly exacting from sensational romanticism!

"Oceanic Birds of South America" constitutes as complete and useful a manual as can be

conceived. It is a synthesis of painstaking research in field, museum and literature ; a book on ecological lines, which treats sea birds not as independent entities, but as parts of the general ocean environment. All the physical factors affecting their lives are carefully considered and analysed. Dr. Murphy's achievement sets a standard in bird books which other writers might do well to emulate.

S. A.

The Biology of Melanism. Special publications of the New York Academy of Sciences. January 1948. Vol. 4. Pp. 1 to 466. \$ 5.00.

The task of reviewing this symposium is very difficult as each article has been written by an expert in his special field and is a complete statement as well as a review, and therefore requiring special study. There are 26 articles on pigment cell biology ; a foreword by Myron Gordon and an introduction by R. G. Harrison. This introduction is a masterpiece, as it succinctly surveys the whole field while introducing the modern ideas of pigment formation in biology ; it reminds one of nandi slokas of one of Kalidasa's dramas where the subject is introduced and where the drama is given a whole glimpse in a few simple words. "Animal colouration has excited the curiosity of man from time immemorial"—"Permanent coloration of organisms is also of great interest"—"including mimicry". The pigmentary system has some of the most malignant tumours known. The study of colour changes shows that the mechanism of control is very complex and depends on nervous control, hormones circulating in the blood, as also environmental factors such as light, temperature, and colour patterns of the surroundings. The skin colour in the amphibia or the plumage of birds, etc., show slowly or quickly changes ; many such changes are very slow and are often or atleast for the most part irreversible.

The source of pigment cells.—A whole article is devoted to it by Dushane. Within the last dozen years, conclusive proof of the origin of pigment cells was advanced. The origin of the Chromatophores from the epiblast is that these are arranged in sheets and can be subdivided into two—Dermal and Epidermal—layers. They are also found in the nervous system ; in mammals only melanophores—found largely in the epidermis remain—the pigment granules passing on to the epidermal cells. Definite experimental evidence by tissue culture and other methods have been obtained by Harrison, Weidenreich and others.

The distribution of Pigment cells in man is discussed by Dr. P. Masson. (This subject is of importance in India where—Vitiligo—depigmented or white areas surrounded by black skin or white leprosy are common and have social stigma.) Pigment cells in mammals have an ectodermal origin. Human melanin is a granular material. Melanin is not black as the name would suggest but varies from dark brown to pale yellow. The silver reaction—i.e., Dopa reaction—darkens all melanins and is a good cytological staining reagent and can

be made satisfactory if the conditions are properly observed. The term *melanoblast* is reserved for the cells which manufacture pigments and *melanophore* to cells which store such pigments, without manufacturing them. The reagent of melanogenesis happens to be an oxidase (-3-4 dihydroxyphenylalanine—"dopa"—for short)—an oxidase acting on the polyphenolic aromatic compounds called Chromogens. Melanoblasts can have momentary activity—as in the eye; or permanent or variable activity—(epidermis and mongolian spot).

Regarding Dermal pigmentation—the pigments are proportional to the intensity of the neighbouring epidermal pigmentation, i.e., in heavier concentrations in dark skinned races. The melanin is imbedded in the more superficial stellate cells of the papillary derma. These cells do not produce the pigment but contain the same in tattoo like granulations. The malpighian cells were thought to be capable of producing melanin; the function of actinic rays is not to manufacture melanin but only to tone the already existing preformed melanin to darker shades; actually the malpighian cells have the pigment brought to them from epidermal melanoblasts.

Hence these melanoblast are glandular secreting cells which send their secretions to other cells; hence they can be called *Cytotines*. In vitiligo the cells are no longer dopa positive. On the other hand, the melanoblasts load cancer cells with pigment even by migrating into intradermal neoplastic strands.

In a clinical study of the pigmented naevi and melanomas, George Pack states that the malignant melanoma or simply melanoma is the most malignant of all accessible cancers; such cancers are most commonly found in blondes though others-brunettes, etc.—are not so completely insusceptible to such melanoma. Pigmented naevi are often apt to turn into melanoma, hence a cytological study should be made of all such excised moles. Melanomas are also notoriously radioresistant. When melanoma in the eyes are removed, metastases occur in the liver where they are known to be quiescent for a number of years. If such tumours occur in the genital organs they are extremely malignant. In a study of melanin pigmentation by William Becker it is made out that in vitiligo, the three cardinal functions of the clear cells have been lost, namely, dopa positivity, dendritic contour and pigment formation.

Samuel Go'dberg discussing the origin of melanoblasts points to the possibility of some melanin pigment cells being of mesodermal origin. (An old view—later given up—owing to the preponderant evidence in favour of ectodermal origin.)

The association of Acanthosis Nigricans (a pigmentary discolouration in the axilla, groin, etc.) with gastric, hepatic and other cancers, is very striking and is emphasised by Madge Macklin.

Various studies on animal melanomas—study by tissue culture method, of melanomas in fish, mouse, human, etc., are also listed.

The effect of five primary genes on the site of melanom's in the mexican platyfish is discussed by Myron Gordon. This is an extremely interesting but very difficult piece of work. Melanotic tumour transplantation has been done to study the effect of melanin formation by transplantation between albino and pigmented grey Axolotl.

Morphological colour changes in the vertebrates is discussed thoroughly by Odrione from various angles. The loss of the pigmentation in hair—changes in birds, fish, hormonal control of pigmentary changes are some of the subjects discussed.

The biochemistry of Melanins and the formation of melanotic tumours are discussed by a number of authors and it will be worth a thorough perusal of the symposium. It may be stated that the subject though difficult, is interesting and the symposium has sought to integrate various view-points as also to show the way for future work. Such books are always welcome.

C. V. NATARAJAN.

The Escalator Method in Engineering Vibration Problems. By Joseph Morris. (Chapman & Hall Ltd., London), 1947. Pp. xv+270. Price 21sh. net.

It would appear that the title of this book was chosen by its mathematical author to intrigue and impress those who have become entangled in engineering vibration problems. Doubtless it succeeds in so doing, which the reviewer considers to be all to the good as, from personal knowledge of the author and his work, he can endorse the appreciation expressed by Professor G. Temple, F.R.S., in the Foreword.

Of the twenty-two chapters, the first six relate to static deflection and stress problems concerning Rods and Structures. These are relevant to the vibration problems examined later but not specifically to the Escalator method. In one of these chapters, Captain Morris gives an important original extension of the Hardy Cross method of moment distribution in redundant structures.

The next three chapters relate respectively to Lord Rayleigh's reciprocal theorems, Approximate methods of determining vibration frequencies, and the Whirling of rotating shafts.

In Chapter 10, the Escalator method of solving Lagrangian frequency equations is introduced. To quote words the reviewer heard Mr. Head use in an open discussion at a professional institution, the basic method had occurred to him as a "blinding flash of the obvious". Captain Morris had immediately appreciated its importance and had developed it in conjunction with Mr. Head and with the strenuous assistance of Mr. W. J. Evans, B.Sc., in dealing with the onerous exploratory computations involved. An important variant of the method, of which an account is given in the book, is the "Escalator in reverse" whereby the solution of certain problems is much facilitated. This useful artifice appears to be due Captain Morris (vide page 138).

In the succeeding chapters of the book, the escalator method is developed in application to the determination of modes and frequencies of vibration for various complex dynamical systems present in aircraft. In particular, coupled engine torsional and propeller flexural vibration is treated in Chapter 14. It would have added to the value of the book to engineers if more generous references had been made to the work of others in this field in respect of both mathematical treatment and experimental observation. Although the escalator method affords a very valuable new instrument for dealing with special problems, other methods not referred to have their application and their merits.

The book has three appendices. Appendix I is a note on numerical integration taken, with due acknowledgement, from Seale's "Experiments in Elasticity". This describes a variant of Simpson's method in which non-uniformly spaced ordinates are used. It is a matter of interest that Simpson's First Rule was given before Simpson's time by James Stirling in his "Methodus Differentialis", published as long ago as 1740. Reference to the general method is welcome because, even now it seems not to be used as widely as it deserves except by Naval Architects, who have long employed it and Tchebycheff's Rules as practical methods of integration.

The other two appendices relate, respectively, to an examination of the fundamental frequency of a freely supported rod of varying section and to the effect of flexibility of propeller blades on gyroscopic couple; in a turn.

The book is well printed, on good paper.
B. C. C.

Introduction to Carbohydrate Bio-Chemistry
By D. J. Bell. (Published by the University Tutorial Press Ltd., London), 1948. Pp. viii + 107. Price 6s. net.

Though written for students reading Biochemistry for Part I of the Natural Sciences Tripos at Cambridge and as Introductory reading for Part II students, this book which discusses in a lucid and succinct manner the recent developments in the Biochemistry of carbohydrates, is worthy of being brought to the notice of students, teachers and research workers in other countries. Sir Frederick Gowland Hopkins, Late Professor of Biochemistry in the University of Cambridge, has contributed a kindly foreword.

The book is divided into eight Chapters. Chapters 1-V deal with the structural formulae and the role played by simple sugars, polysaccharides, glycosides, uronic acids, nucleotides and nucleic acids. Chapter VI gives the most recent conceptions of the synthesis and breakdown of carbohydrates in Nature. This is followed by very well-written chapters on the biological liberation of energy from carbohydrates. The Chapters are amply illustrated with structural formulae of carbohydrates. The discussions of their significance in each chapter are excellent and informative. There is a bibliography at the end of each chapter of important papers for the benefit of the more advanced students.

The book can be heartily recommended to those who wish to understand the role played by carbohydrates and their derivatives in nature and obtain some background of the biochemistry of carbohydrates. Students should derive considerable inspiration from this well-thought-out and well-written book. The printing and get-up of the book show the usual finish of the University Tutorial Press.

K. V. GIRI.

Number Theory and its History. By Oystein Ore. (McGraw Hill Book Co.), 1948. Pp. 370. Price \$ 4.50.

The book provides an account of some of the main problems, methods and principles of the theory of numbers, that one would come across in his study of elementary algebra. The book is not intended as a text-book for the classroom, and although brief mention is made of several problems of a fairly advanced nature, such as primitive roots, converse of Fermat's Theorem, Euler's Theorem, and so on, the treatment is intended for those whose mathematical knowledge is limited. The treatment is however clear and precise, and within the standard contemplated leaves nothing by way of mathematical logic and outlook. The author has certainly succeeded in producing a delightful book which can not only serve as a pastime for the mathematically minded reader, but which will also be a useful book of reference to the mathematics student and teacher, up to the Honours level. An idea of the contents of the book can be had from the headings of some of the chapters: Counting and recording of numbers, Euclid's Algorithm, Indeterminate problems, Diophantine problems, Congruences, Wilson's Theorem and its consequences, Euler's Theorem and its consequences, Theory of Decimal expansions, the Converse of Fermat's Theorem.

The book is interspersed with delightful and brief historical references. In any book on the history of human achievements, the accuracy of facts depends upon the author's first-hand knowledge of diverse civilizations, and his will to be fair-minded. One can agree about the latter with regard to the present author, though it may be asked why the name of Pillai is omitted while that of L. E. Dickson is mentioned in connection with the Waring problem. But the remark, "The use of a positional system with a zero seems to have made its appearance in India in the period A.D. 600-800" cannot be passed over by any Indian, with regard to the dates. The author has taken the trouble of reading Bhaskara and Brahmagupta as depicted by Colebrooke, and does make a reference to Aryabhata. If he had gone through Aryabhata's work, he would have found that square roots and cube roots by almost the same methods as are in vogue now were known in the days of Aryabhata (499 A.D.). Some of the articles in Indian mathematical periodicals dealing with Jaina mathematics of about 500 B.C., and the treatise on the History of Indian Mathematics by Datta and Singh,—not to mention anything about Mohenjo Daro and Harappa civilization of the Indus Valley,—would enable the author to

revise his opinion about the date of the introduction of the positional system.

C. N. S.

The Physics of Music. By R. K. Viswanathan, M.A. (Published by the University, Anna-malainagar), 1948. Pp. 135.

Carnatic music is one of the finest arts of ancient India kept alive through ages by an unbroken line of inspired teachers and their devoted pupils. In recent years, thanks to the gramophone, radio and film, Indian music has received a new impetus and attracts many votaries to its folds. A few schools and academies have sprung up in the country to impart systematic training on modern lines in both vocal and instrumental music. Though music is essentially an art which has its appeal to the emotions and aesthetic senses, its study will never be complete unless its savants understand the scientific bases of the art. The author has done signal service to the students and exponents of Indian music in bringing out in a non-technical but precise form a book dealing with the Physics of Music. The aim of the book is primarily to acquaint the reader with the fundamentals of physics bearing on the main Indian musical instruments belonging to the stringed, wind, reed, membrane and plate families. The book also deals with melody, harmony and timbre in relation to these instruments. The concluding chapters on acoustics of halls and recording and reproduction of sound give useful ideas to the lay-student about topics with which he is intimately concerned. The book is written in simple English and will be a boon to those who have chosen music as a subject of study.

C. S. V.

The Beginnings of Modern Medicine in Madras. By Dr. D. V. S. Reddy. (Thacker, Spink Co., Ltd., Calcutta), 1947. Pp. xvi+251. Price Rs. 5.

To the many who are interested in the history of the growth of modern scientific medicine in India as well as to those who are keen students of the medical institutions in Madras, this book is a valuable and welcome addition to the present scant literature on the subject. Elaborately documented with extracts from Official Proceedings of the East India Company as well as from other sources, it reveals deep and patient exploration into various published and unpublished records and wise discrimination in collecting data. The result is a book which holds the readers' interest from the beginning to the end.

Even as early as 1600 A.D. the East India Company provided two doctors and a barber to every ship that they sent eastwards. There were doctors of three grades "surgeons" with recognised training and certificate, "mates" with a few years' apprenticeship to their credit and "assistants" who had picked up some practical experience working with these professionals. It is interesting to note that even as early as 1621, East India Company told its Officials here that "India had drugs in far greater quantity, plenty and perfection than

here (i.e., England) and that they should buy them in India". They also suggested "that it is safest for the Englishmen to so comporting himself in some manner to the diet of the country".

Many of the East India Company Surgeons who had come from England were in great demand by the Princes and peoples who greatly appreciated the new system of medicine.

A regular new hospital for Madras with qualified Assistants and servants and with proper arrangements for dieting was created about the year 1713 and it was supported by Company's grants, by voluntary subscriptions and by allotting to it certain fines for offences. The Surgeons in charge were allowed to practise and receive fees. They trained assistants and certified them as fit for employment.

Some of the Surgeons in the employ of the East India Company supplemented their professional income by becoming landlords and inamdar and even by trading. The Company occasionally distributed quantities of wine and sherry for the personal use of surgeons.

The chief diseases mentioned as occurring at the time (1670-1720) among the Fort employees and their families are Venereal diseases, Scurvy and Beriberi, Fevers and Dysentery and various injuries. Among the surrounding civil population there were in addition elephantiasis and diseases incidental to maternity.

The main remedies employed were drugs, plasters and unguents supplied in medical chests and local drugs of repute that were available. Wines and liquors were rated as valuable in many complaints. Sea voyage was advised "as a general remedy for chronic ill-health".

From 1827, a regular system of training students was begun and "medical apprentices" and "medical pupils"—according as they were Eurasians or Natives were attached to Surgeons and after a long course were certified and employed.

The book gives very interesting details regarding the then Surgeons and Hospitals of Madras and many facts valuable to the students of the history of the growth of this great city of South India. The author has made a very valuable contribution to the history of the evolution of modern scientific medicine in South India. A very appreciative foreword is written by Surgeon-General J. P. Huban, I. M. S.

B. K. N.

A Hand Book of Precious Stones. By Dr. L. A. N. Iyer. (Baptist Mission Press, Calcutta), 1948. Pp. x+183. Price Rs. 15.

In this small and attractive handbook an attempt has been made to give in popular language a general and scientific account of the properties and composition of precious stones, their occurrence, uses etc., with special reference to India wherever possible.

The first seven chapters of the book deal with the elementary facts of mineralogy that are essential for a correct understanding of the

subject. These chapters are written in extremely simple style and can be easily understood by persons who have had little scientific training. The occurrence, mining, chemical composition and physical properties of gemstones are dealt with in these preliminary chapters. The next two chapters give a general survey of the methods of gem cutting and polishing and the production of artificial and synthetic gems. The methods of differentiating natural gems from synthetic gems are also mentioned. Here the reviewer would like to point out (contrary to the statement made on p. 63) that recently star rubies and sapphires have been synthesised in America.

The second part of the book, consisting of 16 chapters, deals with the modes of occurrence, physical properties and genesis of the various gem stones such as diamond, ruby, sapphire, spinel, chrysobryl, beryl, topaz etc. The locale of occurrence of the various gemstones in India are given in great detail. The methods of mining of gems in foreign countries are contrasted with the crude ones used in India. Statistics of production and consumption in India of the different varieties of precious stones are also given. The brief accounts given about famous gems of the world together with the lore associated with them make interesting reading. The book has a useful table of physical constants of the different precious and semi-precious stones.

The reviewer feels that an addition of more text diagrams and photographs of gems would greatly enhance the usefulness of the book. Its cost also appears a bit too high for the ordinary student of mineralogy interested in gems. But the printing and binding are very satisfactory and the book would be of great value to those interested in precious stones.

S. RAMASESHAN.

The Stuff We're Made Of. By W. O. Kermack and O. Eggleton. (Edward Arnold & Co., London), 1948. Second Edition. Pp. vi + 356. Price 10sh. 6d.

The book under review, which is in its second edition, goes a long way towards fulfilling a keenly felt need for a popular treatise on Biochemistry, written with a clear and sure grasp of its fundamentals. The authors have shown fine discernment in marshalling the obviously endless array of facts into a pattern which is at once simple and coherent. The last chapter especially, which borders on the philosophical, is an admirable summary and review of that vast and growing science as it stands to-day.

The book has been finely got up and is profusely illustrated with many diagrams and choice photographs.

H. R.

Electrical Accidents. By K. V. Karantha, Chief Electrical Inspector to the Government of Madras. (Harsha Printery and Publications, Puttur, Madras.) Pp. iv + 136. Price Rs. 3/8.

The book has been written, according to its author 'with a view to its being of use not only to engineers but also to line inspectors, line-

men, electricians, wiring contractors, managers of factories, etc.' The use of electricity is becoming more common in the domestic, agricultural and industrial fields and therefore it is essential that all those who use it, should have some knowledge about how electrical accidents generally occur and how they can be avoided. The utility of this book is to be judged by examining how far it fulfils that purpose.

"What is the lowest voltage that can be fatal to a person" is a question commonly asked of electrical engineers but there are not many who can satisfactorily answer it. This book is therefore welcome, the more so as it gives a number of actual cases of fatal accidents due to a variety of causes.

Starting from the effect of current on the human body and the resistance of the body under varying conditions, it goes on to deal with the earthed neutral system, the tests to be made before energising an electric installation, and accidents due to negligence in adhering to regulations. Chapters IV and V deal respectively with electrical accidents in industrial establishments and in supply undertakings. Relevant provisions of the Indian Electricity rules are given wherever necessary. There are two chapters dealing with earthing and earth leakage circuit breakers, and one with fires caused by electricity. The last chapter gives us an analysis of electrical accidents. The usefulness of the book is enhanced by the appendices giving some important provisions of the Indian Electricity Act for avoidance of electrical accidents.

Though it must be admitted that most electrical accidents are due not for want of knowledge but because of deliberate carelessness and negligence on the part of the supervising staff (and sometimes of the linemen and coolies), it would be revealing for them to read this book and realise how with a little care in the proper enforcement of the rules, many accidents might have been averted and many an innocent life saved. Equally well would the consumer realise that the regulations exist not to harass him but to protect him.

Quite a number of printing and other errors have crept into the book and the language could have been better. The price is also rather high and it is to be hoped with the author that the Governments and electric supply undertakings, will consider the possibility of bringing out the more important matter contained in this book in the form of pamphlets in local languages fit for distribution to the consumers.

B. N. N.

Unesco Booklet for Science Teachers

An illustrated booklet, "Suggestions for Science Teachers in Devastated Countries", has just been issued by the United Nations Educational, Scientific and Cultural Organisation. The booklet, which shows how teachers lacking elementary scientific equipment can make apparatus from simple, everyday materials, is being distributed free by Unesco to schools in Greece, Poland, Czechoslovakia, Austria, Hungary, Italy, China and the Philippines.

Its author is J. P. Stephenson, science Master at City of London School and member of the Royal Society Committee for Co-operation with Unesco. He first explains how science teaching can be commenced without the use of apparatus and then shows how equipment for experiments in astronomy, meteorology, measurement, heat, light, magnetism, electricity, chemistry and biology can be improvised from materials such as wood, glass-tube, wire, nails, bottles and other household articles.

The booklet also touches on the use of visual aids in science teaching and includes a description of recent laboratory materials, such as plastics and alloys, as well as a section on laboratory receipts, charts and logarithm tables. Suggestions are made clear by well-drawn diagrams.

"These improvisations should not be thought of as makeshifts", the author says in a foreword. "They and the exercise of constructing them, are in the best tradition of science and science teaching. All the great scientists have used such apparatus and many have made their greatest discoveries in this way".

Unesco hopes that teachers in devastated countries will find the book helpful, not only for the concrete suggestions it offers, but also for the stimulus it gives for further improvisation in elementary science. It is possible, too, that teachers in more fortunate countries may derive useful ideas for extending the scope of their classes at little cost.

We should like to add that the publication would be found extremely useful and inspiring to science teachers in India, who are confronted with problem of finding adequate funds for imparting practical instruction in their poorly equipped laboratories.

Ministries of Education are free to reproduce the booklet in English or in translation, provided acknowledgement to Unesco is made.

Hydro-Electric Development in India. (Central Board of Irrigation — Popular Series Leaflet No. 5.)

The leaflet gives a general description of sources that constitute electric power, and the progress hitherto made in India to develop such sources. It points out that though India has a large potential of hydro-electric power in her large rivers and high mountains, estimated to be about 30 to 40 million kW, only about 0.5 million kW or 1.5% of her potential power has been so far developed.

Compared to this slow growth of hydro-electric power in India, from 0.08 million kW in 1920 to 0.5 million kW at present, there have been rapid growths in other countries, for example, in U.S.S.R. waterpower developed at present is 22.4 million kW or about 22% of her potential power compared to nothing developed in 1920. Present day, the consumption of electricity for all purposes *per capita* indicates a true measure of prosperity of a country and which is only 9.2 kW hrs. in India against 4000 in Canada, 3090 in Norway, 2100 in Sweden, 2000 in Switzerland and 1660 in U.S.A. In this connection it is interesting to record that the first hydro-electric development in India was in 1897.

Another, not too wholesome, feature of the scanty progress made in India is the fact that most of the existing installations have been planned to satisfy the demands of the urban areas. Calcutta and Bombay with a total population of 1% of the whole country, between themselves, consume half of the total electric energy produced in India leaving the other half of the power for the remaining 99% of the population; excepting in a few villages in Madras and Mysore, the amenities of electricity are unknown to the common man. Compared to this state of affairs in India, Sweden claims to have electrified 85% of her homes in rural areas.

The pamphlet brings out another important point regarding the use made of the different sources of power in India. India's resources in oil, so far as is known today, are meagre. Her wealth of coal is confined mainly to Bihar, West Bengal, and small outliers in Assam, Central Provinces and Hyderabad. The distribution is uneven and distances from coalfields to different industrial centres so great that except at or near localities where coal mines occur, power cannot be produced economically from coal. Further at the present rate of consumption, the known coal resources of the country would be exhausted in another about 100 years. The Railways in India consume about 7 million tons of coal annually, which is one-third of the total annual consumption in the country. By using large amount of hydro-electric power for traction and other purposes coal could be conserved for other more profitable uses.

The relative growth in the use in India of different sources of power for the production of electrical energy is also worth noting. While the growth in the installed capacity of thermal stations using oil and coal has been from 54.3 MW in 1920 to 852.6 MW in 1947 or about 15.7 times the growth in the capacity of hydro-electric power has been from 79.5 MW in 1920 to 499.2 MW in 1947, i.e., about 6.3 times. On the other hand, the total energy generated by hydro-electric power is greater than from steam power plants.

The leaflet discusses, in summary, the reason for the very slow growth in hydro-electric power development. Amongst many causes mentioned are the denial of freedom of action, the absence or insufficiency of machinery for initiating Central and Provincial projects, unduly expensive nature of some of the early schemes, and the system of financing public works. Except for the development in Mysore, all the early hydro-electric developments in India are the result of private enterprise. The major State-managed hydro-electric work started with the Pykara and Mandi Schemes in 1933. Details of 12 State projects now contemplated in different Provinces and States in India are given. These projects are receiving serious consideration, some of them have passed the initial planning stages and are under construction. These schemes, when completed, will add more than 14 million kW of power to the existing 0.5 million kW of hydro-electric power in India.

The leaflet apart from briefly indicating details of ambitious schemes above mentioned

for the overall progress in the economic and industrial development of the country also rightly points out the necessity of large amount of work in developing research on different branches and subjects allied to such projects and also in the manufacture of essential plant for generation, transmission, and utilisation of such a large amount of electric power.

However, with this contemplated large development of electric power, one wonders whether immediately there will be use of all the power and that the hundreds and thousands of transmission pylons over the countryside carrying bulks of power would not remain idle for a time (a large capital idly blocked up)! Therefore, in addition to what has been mentioned in the leaflet, one can't afford to lose sight of another aspect of such development. If the common people of the country is to be benefitted by these developments it is highly important that immediate steps should be taken to educate the mass, the rural population, in the benefit and uses of electricity for the betterment of their economic and living conditions.

The other comments one might offer are that certain of the projects could do with more looking into. In certain cases it may be worthwhile to reconsider location, design, proposed nature of structure, and examine locations which might result in economic construction. Besides the now announced policy of the Government of India that only projects of a major nature would be immediately undertaken and the rest would have to be deferred to a later date, the projects and the materialisation thereof would involve a prolonged period and most of our rural areas will thus remain unserved for a long time. The development scheme must, therefore, incorporate some other planned programme which would ultimately merge into the overall picture and in the interim period help in the economic uplift. It would be worth considering setting up of small nursery power stations which would fill in the gap for a number of years till all major schemes finally materialise. These stations, when finally closed down or nearer to be closed down, apart from having served their purpose and the useful period of life, would also constitute an effective weapon; (a) for rural and agricultural development, development of cottage industries thus helping to ameliorate the economic conditions; (b) for an intensive impetus for an intensive development of manufacture of prime movers and electric plant in this country, and, (c) for the load building essential for all the projects when they finally come into being.

M. S. THACKER.

Vernalization and Photoperiodism. A Symposium. By Murneck, Whyte, et al. Vol. I. *Lotsaya - A Biological Miscellany.* (The Chronica Botanica Company, Waltham, Mass., U.S.A.), 1948. Pp. 15 + 196. Price \$4.50.

All workers in the field of pre-treatment of crop plants will welcome the publication of this symposium, to which some of the foremost

experimenters have contributed. This is the first volume in a series planned and edited by Dr. Frans Verdoorn, and deals with the biology of flowering.

Starting with an outline of the historical background of research in vernalization and photoperiodism, the next three chapters deal with the physiology of periodicity. Hormonal relationship, the wave-length relationship and nutritional and metabolic relationship to photoperiodism are discussed. This is followed by a chapter on anatomical and histological changes induced in plants by vernalization treatments. Next, H. A. Allard discusses the evolutionary aspect of photoperiodicity, dealing with ancient climatic cycles and length of the day in the past. M. Y. Nuttonson discusses the photoperiodic and thermal requirements of crop plants as revealed by phenological observations.

The chapter on vernalization and photoperiodism in the tropics is by S. M. Sircar, and deals with work done in Indian crop plants. The practical applications of this branch of plant physiology are considered. A briefer article on internal rhythm in a few tropical plants is given by E. Bunning (in German).

Thermoperiodicity, a plant feature likely to be of great importance in tropical agriculture is briefly discussed by F. W. Went, but a certain amount of related information is given in other chapters also.

A. Lang has a note (in German) on a factorial analysis of short-day character in a strain of tobacco, a pioneer contribution to this branch of genetics.

As Kenneth V. Thimann has pointed out in the foreword, this symposium appears at an opportune moment. It presents the known facts in a cogent manner, pointing out at the same time how much more is yet unknown. Because of this able arrangement and discussion, the book will be of great use to investigators in this field, which is likely to be of value to world's agriculture.

The numerous illustrations and photographs add to the value of this book. A complete author index and a general subject index are included.

C. G.

Organic Chlorine Compounds. By Ernest Hamlin Huntress. (Published by John Wiley & Sons, Inc.), 1948. Pp. xxv + 1443. \$27.50.

Organic Chlorine Compounds is the second book in the series of Tables of Data by Prof. Huntress, and presents a summary of data on a selected list of organic compounds containing C, H, O, Cl, described by the author as comprising Order 3; the first two Orders are represented by compounds containing C, H, O and C, H, O, N respectively. The compounds have been arranged into three subdivisions: solids; liquids which can be distilled at ordinary pressure; and liquids which can only be distilled under reduced pressure. One thousand three hundred and twenty individual compounds have been described in detail over 1443 pages. A very valuable aspect of the book is the information

on the methods of preparation, physical and chemical properties, derivatives, references to Beilstein, and the complete literature on the compounds which has been brought up to 1947 as far as possible. The literature on the chemical reactions characteristic of the individual organic chlorine compounds is not only a record of known facts, but indicates in some cases the possibilities for future developments.

Considering the price of the book (\$27.50) it must be regarded as one for reference libraries rather than for personal possession. When judged as a reference book the value of the book is limited in view of the incompleteness of the compilation. Some omissions which were noticed are 1 : 4 : 5 : 8-tetrachloroanthraquinone, the chlorohydroxy-anthraquinones (including 3-chloroalizarin) and the chlorobenzanthrones. D.D.T. is mentioned by this name, but not Gammexane. The author has, however, made it clear that the book is not to be regarded as a substitute for Beilstein, and that the compounds have been selected on the basis of their importance—a heavy responsibility to undertake, since the importance of a compound must depend on one's personal interests. 1 : 4 : 5 : 8-Tetrachloroanthraquinone for instance is a very important dyestuff intermediate.

Classification of organic compounds on the basis of physical properties such as the m.p. or the b.p., as followed in this book, is of doubtful

advantage; and leads to considerable repetition of information regarding compounds which are on the borderline between solids and liquids. It is not often that an organic chemist starts wading through literature for compounds with a given m.p. or b.p., although such a search may prove fruitful in some cases. If the organic chlorine compounds had been classified in the manner of Beilstein, based on rational chemical relationships, the trouble of compiling several indexes, in order to facilitate the location of individual compounds in the book, might have been saved. While the formula, chemical type and alphabetical indexes are valuable, the indexes of empirical formulas according to percentage chlorine and to M.W. are less useful.

Since chlorine and the other halogens do not form part of ring systems, chlorine containing compounds can only be considered as derived from fundamental hydrocarbons or heterocyclic systems. If a separate classification is made, one which includes all the halogens would have been of more value than the compilation of chlorine containing organic compounds alone. While the basis of the arrangement of the organic chlorine compounds is open to criticism, the information on the chlorine compounds included in the book is very exhaustive and of immense assistance to research workers.

K. VENKATARAMAN.

SCIENCE NOTES AND NEWS

Draft Indian Standards for Refractories

The Engineering Division Council of the ISI has brought out three Draft Indian Standards on Fireclay Refractories. They are concerned with Moderate Heat Duty Fireclay Refractories, Group 'A'; Moderate Heat Duty Fireclay Refractories, Group 'B'; and High Heat Duty Fireclay Refractories. These have been prepared by an expert Sectional Committee composed of representatives of manufacturers and consumers of refractories in India. The Committee is headed by Dr. H. K. Mitra of the Tata Iron & Steel Co. Ltd., Jamshedpur.

The drafts on refractories consist of standard specifications for different types of refractories produced in India and the methods for chemical analysis, the determination of pyrometric cone equivalent under load for full size bricks as well as for sections of bricks, the porosity, and the determination of resistance to spalling.

The object of the specifications and tests is to provide an agreed method of evaluation of the three different types of refractories.

In accordance with the procedure of the Indian Standards Institution, every draft specification or code prepared by a Sectional Committee or Sub-Committee, after its approval by the Sectional Committee, is to be issued in proof form for a period to be deter-

mined by the Committee but not less than three months and widely circulated among those likely to be interested, for the purpose of securing critical review and suggestions for improvement. Comments received from all quarters shall be given due consideration by the Sectional Committee; and the revised final draft will then be put up to the Engineering Division Council for endorsement. Before being finally accepted as an Indian Standard it must be approved by the Executive Committee and the General Council of the Institution.

These drafts on Fireclay refractories have been widely circulated to industrialists and technologists in the field. Comments will be received till 29 February 1949, by the Director, Indian Standards Institution, 'P' Block, Raisina Road, New Delhi.

Unified Screw Thread System

An important step towards the standardisation of mechanical products made by Britain, Canada and the U.S.A. is an agreement which has just been reached between these three countries to standardise screw thread.

This means that machine parts of British or American manufacture will be interchangeable, an impossibility for many years because hitherto the angle of threads of screws, bolts and nuts differed by five degrees.

The common standard agreed to now will be known as the Unified Screw Thread system and the agreement as completed will establish seven classes of screw threads with compromise dimensions.

The pact will greatly facilitate the sale and maintenance of mechanical products among the three countries since the replacement of parts for imported motor-cars, washing machines and hundreds of other items can be made in the buyer's own country.

German Publications

Anyone wishing to purchase books published in Germany may do so by placing his order through any bookseller, who may then apply directly to the publisher in Germany. The transaction is administered through the Joint Export and Import Agency of Military Government and payment can be made in the currency of the country in which the original order is placed. The delay in obtaining the book may be a matter of some weeks, or, of course, considerably longer if the publisher has not previously obtained a licence for export from the Joint Export and Import Agency. However, many publishers who foresee a demand outside Germany for a particular book will have obtained the required licence soon after the appearance of the book in Germany. (By courtesy of the Principal Scientific Officer, Unesco, Delhi.)

Indian Institute of Chemical Engineers

The First Annual General Meeting of the Indian Institute of Chemical Engineers was held on 1st and 2nd January, 1949 under the auspices of the Indian Science Congress at Allahabad.

Technical papers on six different chemical engineering problems were read by leading chemical engineers from Bombay, Calcutta, Madras, Delhi, Dhanbad and Waltair. The meeting also conducted a symposium on Chemical Engineering education.

Indian Phytopathological Society

At the second Annual General Meeting of the Society held on January 2, 1949 at Allahabad, the following office-bearers of the Society were elected: President: Dr. S. R. Bose, Vice-President Dr. R. S. Vasudeva. Councillors: Northern Zone—Dr. R. Prasada, Mid-Eastern Zone—Dr. K. C. Mehta Eastern Zone—Mr. S. Y. Padmanabhan, Central Zone (general)—Dr. M. J. Thirumalachar, Western Zone—Dr. M. K. Patel, Southern Zone—Mr. K. M. Thomas. Dr. B. B. Mundkur continues as the Secretary-Treasurer.

Lady Tata Memorial Trust

The Trustees of the Lady Tata Memorial Trust are offering six scholarships of Rs. 250/- each per month for the year 1949-50 commencing from 1st July 1949. Applicants must be of Indian nationality and Graduates in Medicine or Science of a recognised University. The scholarships are tenable in India only

and the holders must undertake to work whole-time under the direction of the head of a recognised research Institute or Laboratory on a subject of scientific investigation that must have a bearing either directly or indirectly on the alleviation of human suffering from disease. Candidates can obtain these instructions and other information they desire from the Secretary of the above Trust, Bombay House, Bruce Street, Fort, Bombay 1.

Elliott Prize for Scientific Research

In accordance with the Government of Bengal Notification No. 1121 Edn., dated 5-5-1917, the Elliott Prize for 1949 for Scientific Research in chemistry will be awarded to the author of the best paper giving the results of original research carried out by the candidate in Chemistry and published during the years 1945-48 inclusive.

Any native of Bengal, Bihar or Orissa or any Anglo-Indian or domiciled European, residing in Bengal, Bihar or Orissa, may compete for the prize.

The recipients of papers (and not manuscripts) must reach the President of the Royal Asiatic Society of Bengal, 1, Park Street, Calcutta, by the end of June, 1949. The prize will be awarded publicly at the Annual General Meeting of the Royal Asiatic Society of Bengal in February, 1950. Preference will be given to researches leading to discoveries likely to develop the industrial resources of Bengal, Bihar or Orissa.

The prize may be in cash or partly in the form of a gold medal and partly in cash. In the event of no essay being deemed of sufficient merit, no prize will be awarded.

The prizes for the next four years will be offered as follows:—

- (i) 1950 — Physics — papers to be submitted by the end of June, 1950.
- (ii) 1951 — Geology and Biology (including Pathology and Physiology) — by the end of June, 1951.
- (iii) 1952 — Mathematics — by the end of June, 1952.
- (iv) 1953 — Chemistry — by the end of June, 1953.

All papers for competition must have been published during the four calendar years immediately preceding the year for which the prize is awarded.

Unesco Fellowship

Professor D. D. Kosambi of the Tata Institute of Fundamental Research of Bombay, has been given a UNESCO fellowship to work on the new types of electronic calculating machines, for setting up a modern calculating laboratory in Asia.

Kosambi has been invited as a visiting Professor by Chicago University. He will also visit the Institute for Advanced Study at Princeton and serve on a committee of mathematicians to select the recipients of Field Medals which will be awarded at the forthcoming International Congress of Mathematicians (Massachusetts).

U. S. Research Fellowship

Awarded a Research Fellowship by the Federal Security Agency of the U.S. Public Health Service, Dr. V. S. Waravdekar, Assistant Research Officer of the Indian Research Fund Association, Government of India, is doing research in cancer at the National Cancer Institute, Bethesda, Maryland. His special field of study is the activity of enzymes in animal tumors screened with different compounds.

Benares Hindu University

On the recommendation of an Examiners' Board of Prof. Norrish, F.R.S., Prof. Emeleus, F.R.S., Sir J. C. Ghosh, Prof. Polanzi, F.R.S. and Melville, F.R.S., Messrs. J. N. Sahey, M.Sc. and S. R. Mohanty, M.Sc. received the Ph.D. of the Benares Hindu University for work on N_2O-H_2 Reaction under Silent Discharge and Joshi-Effect respectively.

Conference on Biological Sciences

In June, 1948, an International Conference on urgent needs and problems in Taxonomic Botany was held under the auspices of the International Union of Biological Sciences, with the aid of UNESCO, at the University of Utrecht, the Netherlands. The Conference, which was held under the chairmanship of Dr. Lanjouw of the Utrecht University Herbarium, concerned itself chiefly with the proposals, received by the Executive Committee for Botanical Nomenclature, for Consideration at the Stockholm Conference. The Conference discussed also a number of other problems and possibilities regarding more effective and closer international co-operation in taxonomic botany.

A report of the conference is in preparation. This will be published in CHRONICA BOTANICA. An advance reprint of the report will be made available in order that it can be distributed well before the Stockholm Conference.

Indian Scientists to Tour Australia

A team of Australian scientists consisting of Sir John Madeson, Sir Kerr Grant, Prof. J. S. Prescott, Mr. R. G. Thomas and Mr. G. B. Gresford visited India in January/March 1948 and were the guests of the Government of India. The result of that visit cemented the friendly relations with Australia. The Australian Government have requested the Government of India to send out a team of Indian scientists on a return visit to Australia as their guests. The Government of India have decided to send out the following team of scientists to Australia for a period of six weeks. The scientists will emplane from Calcutta for Australia on the

19th February 1949. All arrangements in connection with the visit are being made by the Department of Scientific Research.

1. Dr. S. Krishna, C.I.E., Ph.D., D.Sc., F.I.C., F.A.Sc., Director, Forest Products Research, Forest Research Institute, Dehra Dun. (Leader).

2. Lt.-Col. M. L. Ahuja, M.B., Ch.B., M.D., D.P.H., Director, Central Research Station, Kasauli. (Member).

3. Dr. B. P. Pal, M.Sc., Ph.D., F.L.S., F.N.I., Joint Director, Indian Agricultural Research Institute, New Delhi. (Member).

4. Mr. V. P. Sondhi, M.Sc., F.G.S., F.N.I., Deputy Director, Geological Survey of India, Calcutta. (Member).

5. Dr. K. N. Mathur, D.Sc., F.N.I., Assistant Director, National Physical Laboratory, New Delhi. (Secretary).

The team of scientists will tour Australia and will visit different research organisations and scientific institutes which are of particular interest to each of them. The visit of our scientists to Australia will lead to the exchange of valuable scientific information and help to strengthen the already existing ties of friendship between India and Australia.

Prof. Chapman at Ahmedabad

Professor Sydney Chapman, F.R.S., Professor of Mathematics in the University of Oxford, distinguished geophysicist, and President of the Association of Terrestrial Magnetism of the International Union of Geodesy and Geophysics, has kindly agreed to deliver a course of eight lectures in the Physical Research Laboratory, Ahmedabad, on "Geomagnetism and Related Phenomena". The lectures will be held daily and are expected to commence on the 24th January 1949.

Royal Institute of Science, Bombay

Sir C. V. Raman will deliver a series of six lectures on the Scattering of Light in Liquids and Solids beginning from January 31st, under the auspices of the Royal Institute of Science, Bombay.

Trombicula deliensis, Vector of Typhus

The Director, Institute of Hygiene, Calcutta, has sent us a telegraphic announcement under date 31st December 1948 that:

Drs. K. V. Krishnan and R. O. A. Smith after developing a technique for breeding *Trombicula deliensis* in the laboratory over several generations, have used these mites in transmission experiments with white mouse as the test animal and obtained proof that *T. deliensis* larvae are the Vectors of Typhus in Bengal. This work was carried out at the All-India Institute of Hygiene and Public Health, Calcutta, under a grant from the Indian Research Fund Association.